

**REPORT OF
AIR POLLUTION SOURCE TESTING
OF AN ETHYLENE OXIDE EMISSION-CONTROL SYSTEM
OPERATED BY STERIGENICS, INC.
IN ATLANTA, GEORGIA
ON MARCH 17-18, 2016**

Submitted to:

**GEORGIA DEPARTMENT OF NATURAL RESOURCES
Environmental Protection Division
4244 International Parkway, Suite 120
Atlanta, Georgia 30354**

Submitted by:

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GDNR Permit Number 7839-067-0093-S-05-3

Prepared by:

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April 21, 2016

ECSi

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TEST DATE

March 17-18, 2016

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1.0 INTRODUCTION

On Thursday and Friday, March 17-18, 2016, ECSi, Inc. performed air pollution source testing of an ethylene oxide (EtO) emission-control device operated by Sterigenics, Inc. in Atlanta, Georgia. The control device tested was a Ceilcote packed tower scrubber emission-control system, which is currently used to control emissions from ten EtO sterilizer vacuum pumps. The purpose of the testing program was to demonstrate continued compliance with the conditions established in the Air Quality Permit granted to Sterigenics by the Georgia Department of Natural Resources, Environmental Protection Division (GDNR).

2.0 EQUIPMENT

The EtO gas-sterilization system is comprised of ten commercial sterilizers, which are discharged through liquid-ring vacuum pumps to a Ceilcote packed tower scrubber emission-control system, ten sterilizer exhaust vents (backvents) and one aeration room, which are discharged to a two-stage Advanced Air Technologies (AAT) Safe Cell emission-control system. As an alternative emission-control scenario, the facility also has the capability to discharge the sterilization chamber vacuum pumps to the AAT Safe Cell system. The gas-sterilization and emission-control equipment consist of the following:

- Ten Gas Sterilizers, two 5-pallet, two 6-pallet, four 13-pallet, and two 30-pallet capacity, each comprised of a steam-heated sterilization chamber, a recirculating vacuum pump chamber evacuation system, a backvent valve, and a fugitive emissions exhaust hood;
- One aeration room (AR-1), 152,400 cubic feet capacity, comprised of a heated aeration chamber and a chamber exhaust system.

Sterilizer vacuum pump emissions are be controlled by:

- One Ceilcote packed tower chemical scrubber, equipped with: a reaction/interface column, 27' 4" high, 42" in diameter, with a 20' bed of #1 Tellerette packing; a 115 GPM scrubber fluid recirculation system; and two 28,000 gallon reaction/storage tanks.

Sterilizer backvent and aeration emissions are controlled by:

- One two-stage Advanced Air Technologies Safe Cell emission-control system, comprised of a packed-tower chemical scrubber (SC1), equipped with a packed reaction/interface column, a scrubber fluid recirculation system, and a scrubber fluid reaction/storage tank, and a dry bed reactor/scrubber (SC2), comprised of a bank of solid-bed reaction vessels, connected in parallel, installed downstream of SC1 and upstream of a dedicated blower exhaust system.

3.0 TESTING

EtO source testing was conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the packed tower scrubber during the first chamber evacuation of the sterilizer exhaust phase of one of the ten currently operating sterilizers, and at least one of the test runs was performed using emissions from the new 30-pallet sterilizer. A total of three exhaust-phase test runs were performed.

During the first chamber evacuation of the exhaust phase, EtO emissions to the inlet of the packed tower scrubber were determined using the Ideal Gas Law and the chamber conditions at the beginning and at the end of the first chamber evacuation. During the first chamber evacuation of the exhaust phase, EtO emissions from the outlet of the packed tower scrubber were determined using direct source sample injection into the GC.

All exhaust phase testing was conducted during normal process load conditions, but with an empty sterilization chamber to facilitate inlet mass calculation and the performance of multiple test runs. The testing program was conducted in accordance with the procedures outlined in the following sections.

4.0 RULE/COMPLIANCE REQUIREMENTS

The EtO gas-sterilization system at Sterigenics was tested to demonstrate compliance with the EPA requirements, as specified in the GDNR Air Quality Permit. The following requirements must be met:

- The sterilizer exhaust phase (post exposure vacuum pulses) emissions must be vented to control equipment with an EtO emission-reduction efficiency of at least 99 % by weight.

Testing is required to demonstrate compliance with these requirements. Source testing of the packed tower scrubber emission-control device is required initially, and may be required periodically thereafter.

5.0 TEST METHOD REFERENCE

5.1 INTRODUCTION

EtO source testing was conducted in accordance with the procedures outlined in USEPA CFR40, Part 63.365. EtO emissions monitoring was conducted simultaneously at the inlet and outlet of the packed tower scrubber during the first chamber evacuation of the sterilizer exhaust phase of one of the ten currently operating sterilizers, and at least one of the test runs was performed using emissions from the new 30-pallet sterilizer. A total of three exhaust-phase test runs were performed.

Exhaust phase testing with one sterilizer discharging to the scrubber at a time represents worst-case conditions for demonstration of control efficiency compliance. At this lower inlet loading, the scrubber must perform at its maximum efficiency to achieve outlet EtO concentrations low enough to demonstrate compliance. One of the larger sterilizers was tested for each of the test runs to provide a realistic operational scenario.

During the first chamber evacuation of the exhaust phase, EtO emissions to the inlet of the packed tower scrubber were determined using the Ideal Gas Law and the chamber conditions at the beginning and at the end of the first chamber evacuation. During the first chamber evacuation of the exhaust phase, EtO emissions from the outlet of the packed tower scrubber were determined using direct source sample injection into the GC.

All exhaust phase testing was conducted during normal process load conditions, but with an empty sterilization chamber to facilitate inlet mass calculation and the performance of multiple test runs. The testing program was conducted in accordance with the procedures outlined in the following sections.

Operation and documentation of process conditions was performed by personnel from Sterigenics, Inc. using existing monitoring instruments installed by the manufacturer on the equipment to be tested. In accordance with the procedures established in USEPA CFR40, Part 63, Subpart O, scrubber liquor level was recorded. This parametric monitoring data is attached as Appendix G.

5.2 VOLUMETRIC FLOW MEASUREMENT

Exhaust gas flow at the outlet of the scrubber was determined by 40 CFR 60, Appendix A, Method 2, using an s-type pitot tube and an inclined-oil manometer. Sampling ports were located in accordance with 40 CFR 60, Appendix A, Method 1. The test ports were located far enough from any flow disturbances to permit accurate flow measurement.

Temperature measurements were obtained from a type K thermocouple and thermometer attached to the sampling probe. Exhaust gas composition was assumed to be air and small amounts of water vapor. Water vapor was negligible and, based on previous test data, a value of 2 percent was used for flow calculations.

5.3 CONTROL EFFICIENCY AND MASS EMISSIONS MEASUREMENT

During the first chamber evacuation of the sterilizer exhaust phase, the mass emissions of EtO vented to the inlet of the scrubber were determined using the procedures outlined in CFR40, Part 63.365. This method allows the determination of the mass of EtO vented to the inlet of the scrubber through calculations based on the Ideal Gas Law and using the conditions (pressure, temperature, volume) of the sterilization chamber immediately after it has been charged with sterilant gas, and upon conclusion of the first chamber evacuation of the exhaust phase.

The mass of EtO vented to the inlet of the scrubber during the first chamber evacuation of the exhaust phase was determined by calculating the mass of EtO present in the chamber after the first chamber evacuation and subtracting it from the mass of EtO present in the chamber after it had been charged with sterilant gas. The mass of EtO present in the chamber was calculated using Equation 1, shown below in Section 5.9.

During the first chamber evacuation of the sterilizer exhaust phase, EtO emissions from the outlet were determined using direct source sample injection into the GC. The mass of EtO emitted from the outlet was determined using Equation 2, shown below in Section 5.9. Mass-mass control-efficiency of EtO during the sterilizer exhaust phase was calculated by comparing the mass of EtO vented to the system inlet to the mass of EtO vented from the system outlet.

During the sterilization chamber exhaust phase, vented gas was analyzed by an SRI, Model 8610, portable gas chromatograph (GC), equipped with the following: dual, heated sample loops and injectors; dual

columns; and dual detectors. A photoionization detector (PID) was used to quantify low-level EtO emissions at the packed tower scrubber outlet.

5.4 SAMPLE TRANSPORT

Source gas was pumped to the GC at approximately 500-1000 cubic centimeters per minute (cc/min) from the sampling ports through two lengths of Teflon[®] sample line, each with a nominal volume of approximately 75 cubic centimeters (cc) and an outer diameter of 0.25 inch. At the outlet of the scrubber the sampling ports were located in the exhaust stack.

5.5 GC INJECTION

Source-gas samples were then injected into the GC which was equipped with two heated sampling loops, each containing a volume of approximately 2cc and maintained at 100 degrees Celsius (C). Injections occurred at approximately one-minute intervals during the sterilization chamber exhaust phase. Helium was the carrier gas for the PID.

5.6 GC CONDITIONS

The packed columns for the GC were both operated at 80 degrees C. The columns were stainless steel, 6 feet long, 0.125 inch outer diameter, packed with 1 percent SP-1000 on 60/80 mesh Carbopack B.

Any unused sample gas was vented from the GC system back to the inlet of the scrubber.

5.7 CALIBRATION STANDARDS

The PID was calibrated for low-range ppmv level analyses using gas proportions similar to the following:

- 1) 100 ppmv EtO, balance nitrogen
- 2) 50 ppmv EtO, balance nitrogen (audit gas)
- 3) 10 ppmv EtO, balance nitrogen
- 4) 1 ppmv EtO, balance nitrogen

Each of these calibration standards was in a separate, certified manufacturer's cylinder. Copies of the calibration gas laboratory certificates are attached as Appendix F.

5.8 SAMPLING DURATION

Exhaust phase EtO measurements were taken for the entire duration of the first chamber evacuation, which was approximately 20-30 minutes. This encompassed a total sampling duration of approximately 20-30 minutes for each exhaust phase test run.

5.9 CONTROL-EFFICIENCY/MASS-EMISSIONS CALCULATIONS

The following equation was used to calculate mass of EtO discharged to the inlet of the emission-control system during the first chamber evacuation of the sterilizer exhaust phase:

EQUATION 1:

$$W_c = W_{ci} - W_{cf}$$

Where:

W_c = Weight of EtO discharged from the sterilization chamber to the emission-control system during the first chamber evacuation, pounds

$$W_{ci} = (mw)(p)(P)(V)/(R)(T)$$

(and W_{cf})

Where:

W_{ci} = Weight of EtO present in the sterilization chamber before the first chamber evacuation, pounds

W_{cf} = Weight of EtO present in the sterilization chamber after the first chamber evacuation, pounds

MW = Molecular weight of EtO, 44.05 lb/mol

p = Percent of EtO in chamber

$$= W_s/W_i$$

Where:

W_s = Scale-measured weight of EtO charged into sterilization chamber

W_i = Calculated weight of EtO charged into sterilization chamber (@ 100%)

P = Sterilization chamber pressure (after charging/at the end of the 1st evac), psia

V	=	Sterilization chamber volume, ft ³
R	=	Gas constant, 10.73 psia·ft ³ /mol·°R
T	=	Sterilization chamber temperature (after charging/at the end of the 1st evac), °R

Note: Standard conditions are 68°F and 1 atm.

Mass emissions of EtO during the exhaust phase were calculated using the following equation:

EQUATION 2:

$$\text{MassRate} = (\text{VolFlow})(\text{MolWt})(\text{ppmv EtO}/10^6)/(\text{MolVol})$$

Where:

MassRate = EtO mass flow rate, pounds per minute

VolFlow = Corrected volumetric flow rate, standard cubic feet per minute at 68 degrees F

MolWt = 44.05 pounds EtO per pound mole

ppmv EtO = EtO concentration, parts per million by volume

10⁶ = Conversion factor, ppmv per "cubic foot per cubic foot"

MolVol = 385.32 cubic feet per pound mole at one atmosphere and 68 degrees F

Results of the control-efficiency testing are presented in Section 8.0 and in Table 1.

6.0 TEST SCENARIO

During exhaust phase testing, each sterilizer was tested during normal process load conditions, but with an empty sterilization chamber to facilitate the performance of multiple test runs. A total of three exhaust-phase test runs were performed to verify the performance of the emission-control device. Testing was conducted with an effort to offer minimal disruption to the Sterigenics production schedule. The testing schedule was as follows:

- 1) Testing equipment was set up and calibrated.
- 2) An empty-chamber cycle was started in one of the larger sterilizers. This sterilizer was isolated for test use and designated as a test chamber.
- 3) Exhaust Phase Test Run #1 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
- 4) An empty-chamber cycle was started in another of the larger sterilizers. This sterilizer was isolated for test use and designated as a test chamber.
- 5) Exhaust Phase Test Run #2 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
- 6) An empty-chamber cycle was started in the new 30-pallet sterilizer. This sterilizer was isolated for test use and designated as a test chamber.
- 7) Exhaust Phase Test Run #3 was conducted. Sampling was performed at outlet of the scrubber during the first chamber evacuation of the test chamber. During the performance of the test, only the sterilizer used for the test was allowed to discharge to the Ceilcote scrubber.
- 8) Post calibration check was performed, testing equipment was packed.

7.0 QA/QC

7.1 FIELD TESTING QUALITY ASSURANCE

At the beginning of the test, the sampling system was leak checked at a vacuum of 15 inches of mercury. The sampling system was considered leak free when the flow indicated by the rotameters fell to zero.

At the beginning of the test, a system blank was analyzed to ensure that the sampling system was free of EtO. Ambient air was introduced at the end of the heated sampling line and drawn through the sampling system line to the GC for analysis. The resulting chromatogram also provided a background level for non-EtO components (i.e. ambient air, carbon dioxide, water vapor) which are present in the source gas stream due to the ambient dilution air which is drawn into the emission-control device, and due to the destruction of EtO by the emission-control device which produces carbon dioxide and water vapor. This chromatogram, designated AMB, is included with the calibration data in Appendix A.

7.2 CALIBRATION PROCEDURES

The GC system was calibrated at the beginning and conclusion of each day's testing. Using the Peaksimple II analytical software, a point-to-point calibration curve was constructed for each detector. A gas cylinder of similar composition as the calibration gases, but certified by a separate supplier, was used to verify calibration gas composition and GC performance.

All calibration gases and support gases used were of the highest purity and quality available. A copy of the laboratory certification for each calibration gas is attached as Appendix F.

8.0 TEST RESULTS

The Ceilcote scrubber demonstrated an EtO control efficiency of 99.99998 percent. In accordance with EPA requirements, as specified in the GDNR Air Quality Permit, this control equipment must have an EtO control efficiency of 99 percent or more during the sterilizer exhaust phase (vacuum pump emissions). The emission-control device met this requirement.

The test results are summarized in Table 1. These tables include results for EtO control efficiency of the emission-control device. Chromatograms and chromatographic supporting data are attached as Appendices A through D. Copies of field data and calculation worksheets are attached as Appendix E.

TABLES

TABLE 1
ETHYLENE OXIDE CONTROL EFFICIENCY
OF A CEILCOTE PACKED TOWER SCRUBBER EMISSION CONTROL DEVICE
OPERATED BY STERIGENICS, INC.
IN ATLANTA, GEORGIA
ON MARCH 17-18, 2016

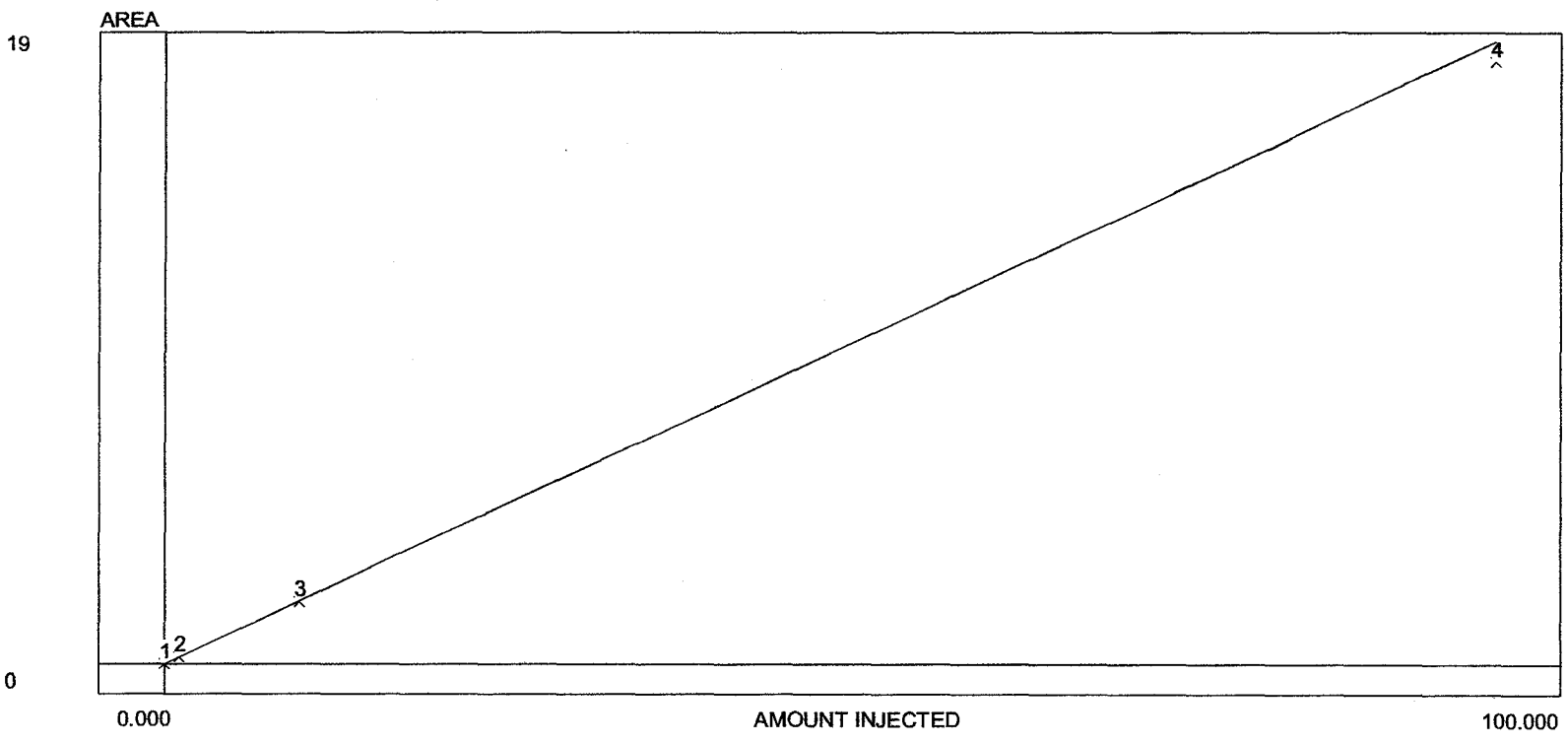
<u>Run #</u>	<u>Stack Flow (dscfm) (2)</u>	<u>Average Outlet Conc. (ppm) (1)</u>	<u>Outlet EtO Mass Flow (lbs/min) (3)</u>	<u>Minutes/ Cycle</u>	<u>Outlet EtO Mass Emissions (lbs)</u>	<u>Inlet EtO Mass Emissions (lbs)</u>	<u>EtO Control Efficiency (%)</u>
#1	235	0.0100	0.0000003	24	0.0000065	44.9	99.999986
#2	262	0.0214	0.0000006	23	0.0000141	61.9	99.999977
#3	332	0.0100	0.0000004	20	0.0000076	76.1	99.999990
Average EtO Control Efficiency:							99.999984
Required EtO Control Efficiency:							99

Notes: (1) - PPM = parts per million by volume
(2) - DSCFM = dry standard cubic feet per minute
(3) - LBS/MIN = EtO emissions, pounds per minute

APPENDICES

APPENDIX A
Calibration Data

Peak	Name	Start	End	Calibration	Int.Std	Units
1	Dead Vol / Air	0.000	0.350		0.000	
2	Ambient H2O	0.350	0.500		0.000	
3	Ethylene Oxide	0.500	0.600	C:\peak359\1Ster	0.00016	ppm
4	Acetaldehyde	0.600	0.800		0.000	
5	CO2	0.800	1.000		0.000	

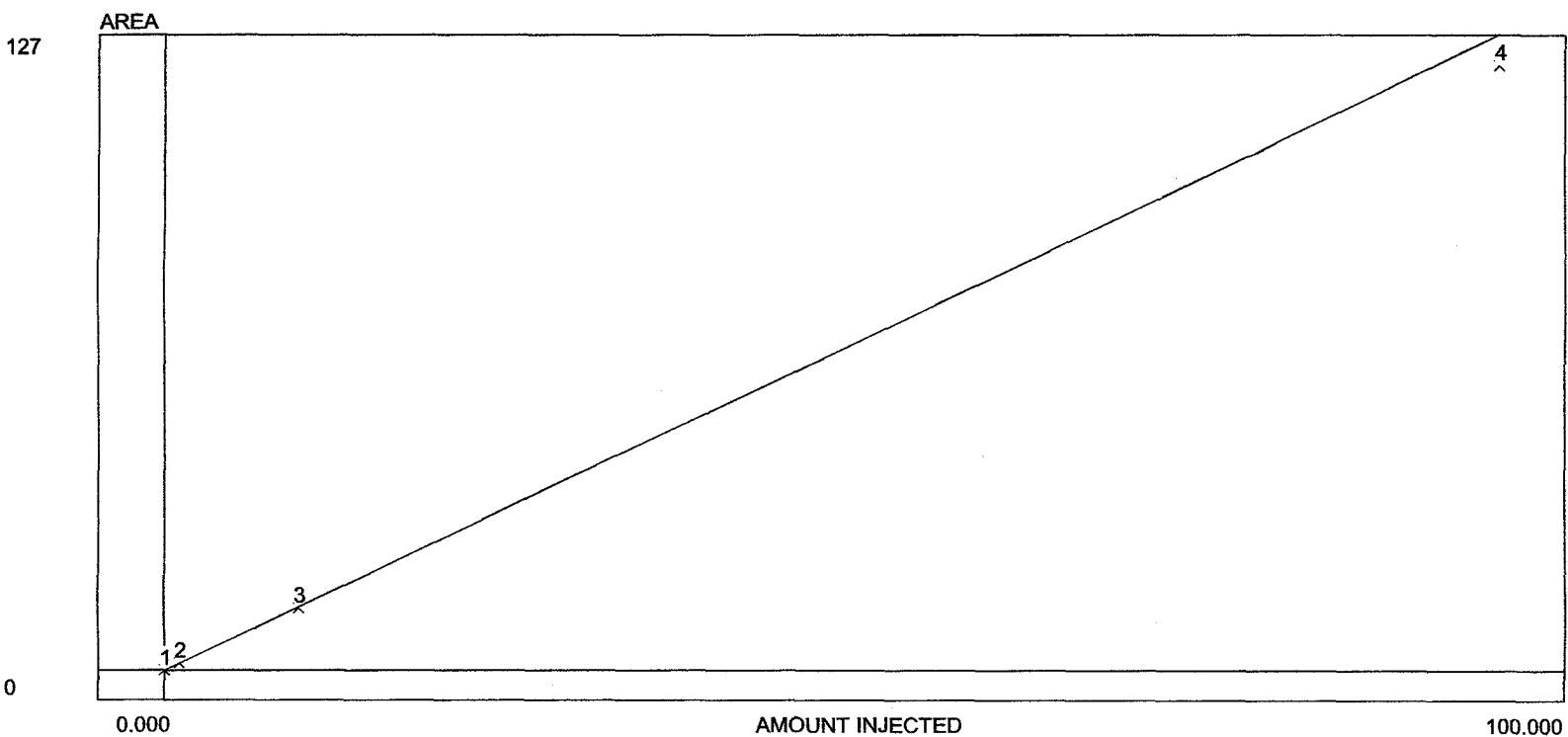


Avg slope of curve: 0.20
Y-axis intercept: 0.00
Linearity: 1.00
Number of levels: 4
SD/rel SD of CF's: 0.1/66.8
Y=0.2007X
r2: 1.0000
Last calibrated: Thu Mar 17 17:12:29 2016

Lvl.	Area/ht.	Amount	CF	Current	Previous #1	Previous #2
1	0.000	0.000	0.000	0.000	N/A	N/A
2	0.230	1.100	0.209	0.230	N/A	N/A
3	2.010	10.100	0.199	2.010	N/A	N/A
4	19.400	100.000	0.194	19.400	N/A	N/A

Component file: 359\2Ster0.00016.ppm

Peak	Name	Start	End	Calibration	Int.Std	Units
1	Dead Vol / Air	0.000	0.350		0.000	
2	Ambient H2O	0.350	0.490		0.000	
3	Ethylene Oxide	0.490	0.600	C:\peak359\2Ster0.00016.ppm	0.00016	ppm
4	Acetaldehyde	0.600	0.800		0.000	
5	CO2	0.800	1.000		0.000	



Avg slope of curve: 1.34

Y-axis intercept: 0.00

Linearity: 1.00

Number of levels: 4

SD/rel SD of CF's: 0.7/67.0

Y=1.3350X

r2: 1.0000

Last calibrated: Thu Mar 17 17:11:52 2016

Lvl.	Area/ht.	Amount	CF	Current	Previous #1	Previous #2
1	0.000	0.000	0.000	0.000	N/A	N/A
2	1.560	1.100	1.418	1.560	N/A	N/A
3	13.300	10.100	1.317	13.300	N/A	N/A
4	127.000	100.000	1.270	127.000	N/A	N/A

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:29:46

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carbopack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-Amb.CHR (c:\peak359)

Sample: Ambient Background

Operator: D. Kremer

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:29:46

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carbopack B

Carrier: HELIUM

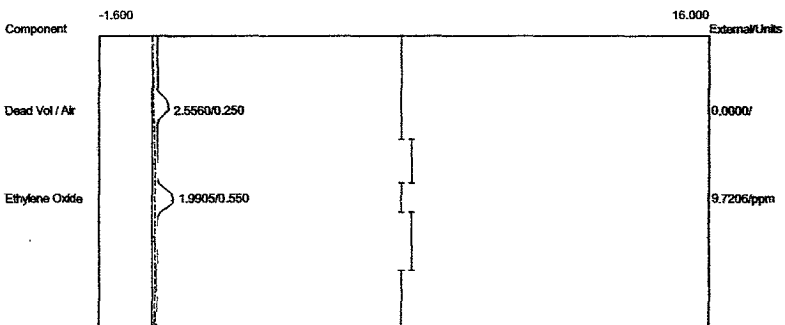
Temp. prog: eto-100.tem

Components: eto2-100.cpt

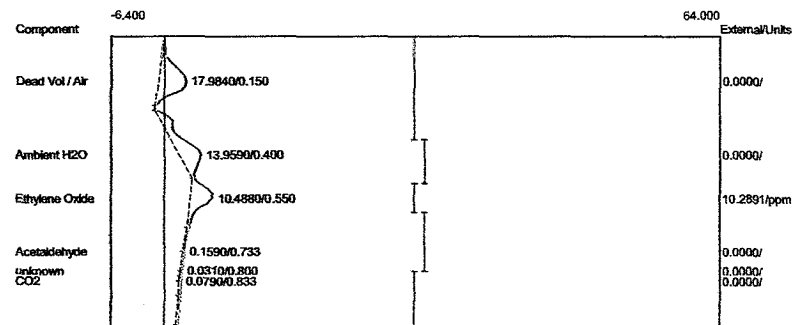
Data file: 2SterAtl-2016-Amb.CHR (c:\peak359)

Sample: Ambient Background

Operator: D. Kremer



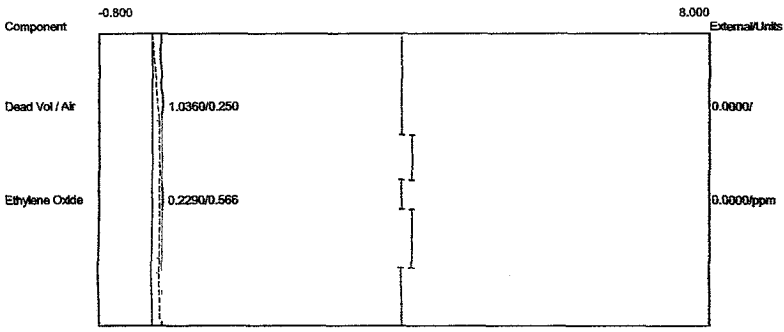
Component	Retention	Area	External Units
Dead Vol / Air	0.250	2.5560	0.0000
Ethylene Oxide	0.550	1.9905	9.7206 ppm
		4.5465	9.7206



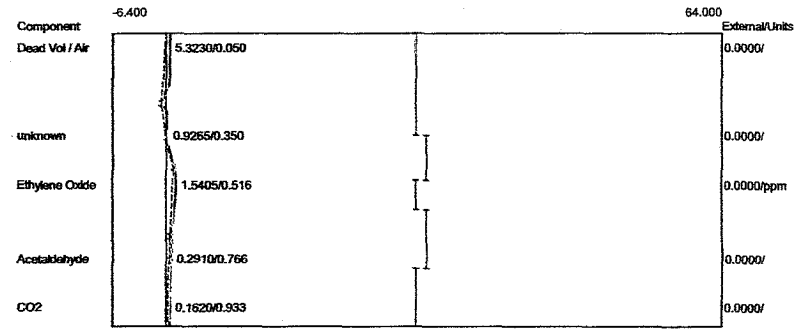
Component	Retention	Area	External Units
Dead Vol / Air	0.150	17.9840	0.0000
Ambient H2O	0.400	13.9590	0.0000
Ethylene Oxide	0.550	10.4880	10.2891 ppm
Acetaldehyde	0.733	0.1590	0.0000
CO2	0.833	0.0790	0.0000
		42.6690	10.2891

Lab name: EOC
Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:36:23
Method: Direct Injection
Description: CHANNEL 1 - FID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto1-100.cpt
Data file: 1SterAtl-2016-C01.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer

Lab name: EOC
Client: Sterigenics - Atlanta
Client ID: PreCal
Analysis date: 03/17/2016 16:36:23
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-C01.CHR (c:\peak359)
Sample: 1.10 ppm EtO std
Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.250	1.0360	0.0000
Ethylene Oxide	0.566	0.2290	0.0000 ppm
		1.2650	0.0000



Component	Retention	Area	External Units
Dead Vol / Air	0.050	5.3230	0.0000
Ethylene Oxide	0.516	1.5405	0.0000 ppm
Acetaldehyde	0.766	0.2910	0.0000
CO2	0.933	0.1620	0.0000
		7.3165	0.0000

Lab name: EOC

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:42:02

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carboxack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-C02.CHR (c:\peak359)

Sample: 1.10 ppm EtO std

Operator: D. Kremer

Lab name: EOC

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:42:02

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carboxack B

Carrier: HELIUM

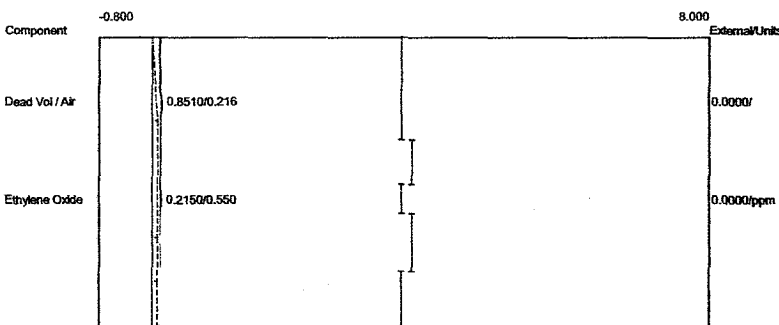
Temp. prog: eto-100.tem

Components: eto2-100.cpt

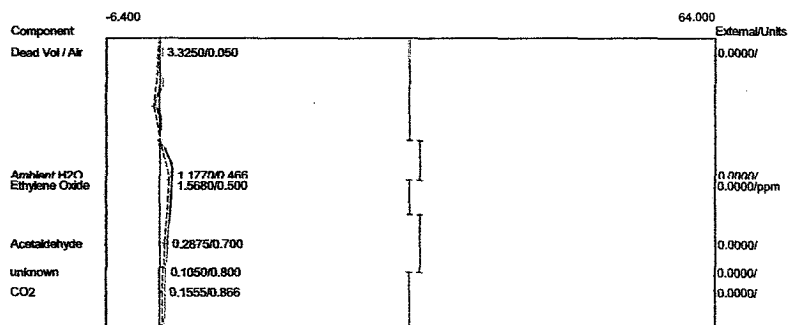
Data file: 2SterAtl-2016-C02.CHR (c:\peak359)

Sample: 1.10 ppm EtO std

Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.216	0.8510	0.0000
Ethylene Oxide	0.550	0.2150	0.0000 ppm
		1.0660	0.0000



Component	Retention	Area	External Units
Dead Vol / Air	0.050	3.3250	0.0000
Ambient H2O	0.466	1.1770	0.0000
Ethylene Oxide	0.500	1.5680	0.0000 ppm
Acetaldehyde	0.700	0.2875	0.0000
CO2	0.866	0.1555	0.0000
		6.5130	0.0000

Lab Name: ECC

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:48:30

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-C03.CHR (c:\peak359)

Sample: 10.1 ppm EtO std

Operator: D. Kremer

Lab Name: ECC

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:48:30

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

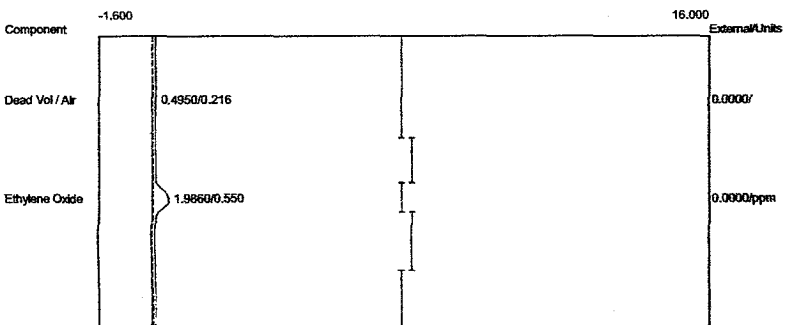
Temp. prog: eto-100.tem

Components: eto2-100.cpt

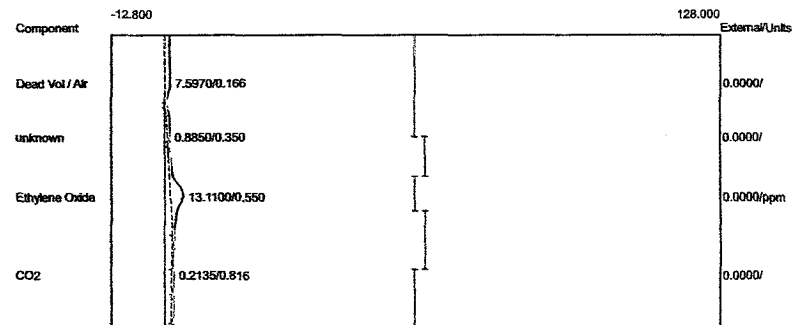
Data file: 2SterAtl-2016-C03.CHR (c:\peak359)

Sample: 10.1 ppm EtO std

Operator: D. Kremer



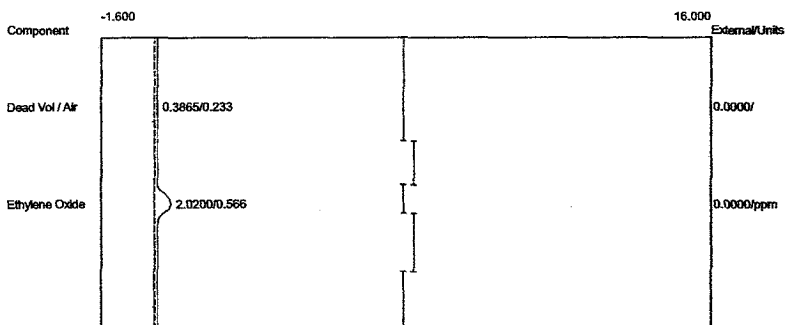
Component	Retention	Area	External	Units
Dead Vol / Air	0.216	0.4950	0.0000	
Ethylene Oxide	0.550	1.9860	0.0000	ppm
		2.4810	0.0000	



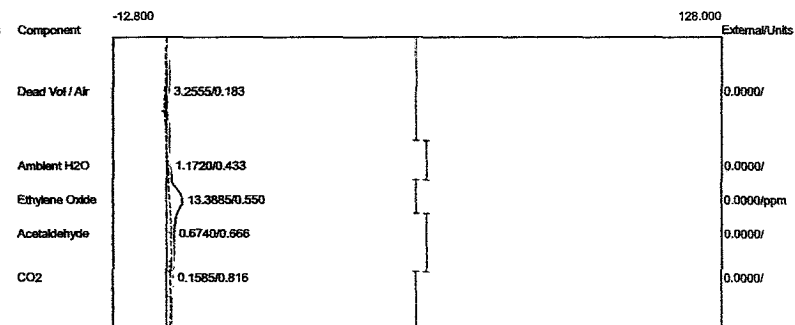
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	7.5970	0.0000	
Ethylene Oxide	0.550	13.1100	0.0000	ppm
CO2	0.816	0.2135	0.0000	
		20.9205	0.0000	

Lab Name: 1001
 Client: Sterigenics - Atlanta
 Client ID: PreCal
 Analysis date: 03/17/2016 16:50:18
 Method: Direct Injection
 Description: CHANNEL 1 - FID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto1-100.cpt
 Data file: 1SterAtl-2016-C04.CHR (c:\peak359)
 Sample: 10.1 ppm EtO std
 Operator: D. Kremer

Lab Name: 1001
 Client: Sterigenics - Atlanta
 Client ID: PreCal
 Analysis date: 03/17/2016 16:50:18
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-C04.CHR (c:\peak359)
 Sample: 10.1 ppm EtO std
 Operator: D. Kremer



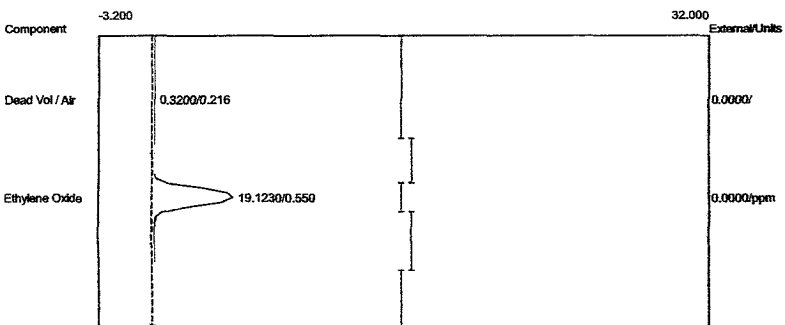
Component	Retention	Area	External Units
Dead Vol / Air	0.233	0.3865	0.0000
Ethylene Oxide	0.566	2.0200	0.0000 ppm
		2.4065	0.0000



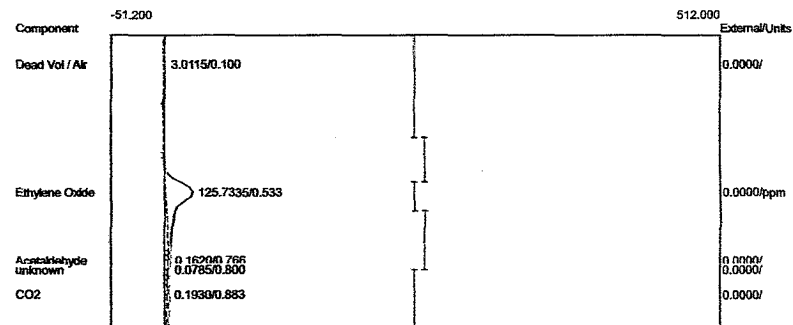
Component	Retention	Area	External Units
Dead Vol / Air	0.183	3.2555	0.0000
Ambient H2O	0.433	1.1720	0.0000
Ethylene Oxide	0.550	13.3885	0.0000 ppm
Acetaldehyde	0.666	0.6740	0.0000
CO2	0.816	0.1585	0.0000
		18.6485	0.0000

Lab Name: EOC
 Client: Sterigenics - Atlanta
 Client ID: PreCal
 Analysis date: 03/17/2016 16:55:19
 Method: Direct Injection
 Description: CHANNEL 1 - FID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto1-100.cpt
 Data file: 1SterAtl-2016-C05.CHR (c:\peak359)
 Sample: 100 ppm EtO std
 Operator: D. Kremer

Lab Name: EOC
 Client: Sterigenics - Atlanta
 Client ID: PreCal
 Analysis date: 03/17/2016 16:55:19
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-C05.CHR (c:\peak359)
 Sample: 100 ppm EtO std
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.216	0.3200	0.0000	
Ethylene Oxide	0.550	19.1230	0.0000	ppm
		19.4430	0.0000	



Component	Retention	Area	External	Units
Dead Vol / Air	0.100	3.0115	0.0000	
Ethylene Oxide	0.533	125.7335	0.0000	ppm
Acetaldehyde	0.766	0.1620	0.0000	
CO2	0.883	0.1930	0.0000	
		129.1000	0.0000	

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:57:53

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-C06.CHR (c:\peak359)

Sample: 100 ppm EtO std

Operator: D. Kremer

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 16:57:53

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

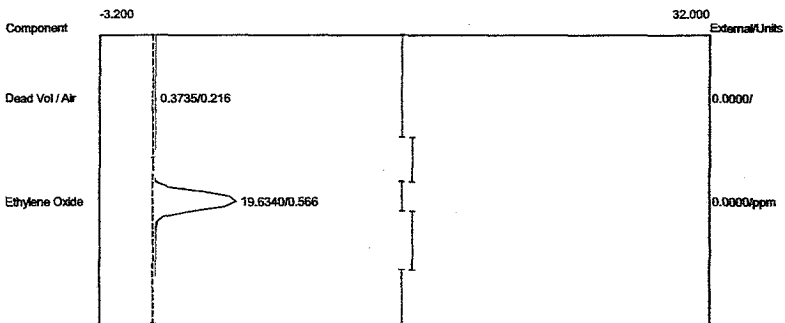
Temp. prog: eto-100.tem

Components: eto2-100.cpt

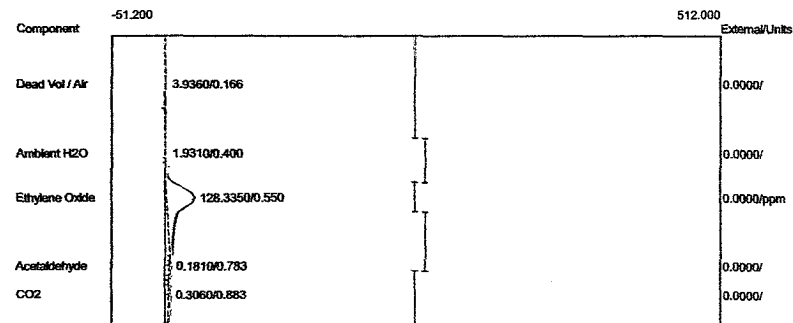
Data file: 2SterAtl-2016-C06.CHR (c:\peak359)

Sample: 100 ppm EtO std

Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.216	0.3735	0.0000
Ethylene Oxide	0.566	19.6340	0.0000 ppm
		20.0075	0.0000



Component	Retention	Area	External Units
Dead Vol / Air	0.166	3.9360	0.0000
Ambient H2O	0.400	1.9310	0.0000
Ethylene Oxide	0.550	128.3350	0.0000 ppm
Acetaldehyde	0.783	0.1810	0.0000
CO2	0.883	0.3060	0.0000
		134.6890	0.0000

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 17:10:35

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carbopack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-C07.CHR (c:\peak359)

Sample: 48.8 ppm EtO std

Operator: D. Kremer

Lab name: ECS1

Client: Sterigenics - Atlanta

Client ID: PreCal

Analysis date: 03/17/2016 17:10:35

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carbopack B

Carrier: HELIUM

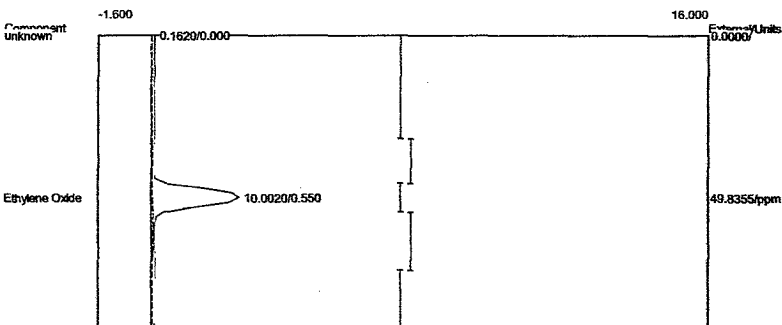
Temp. prog: eto-100.tem

Components: eto2-100.cpt

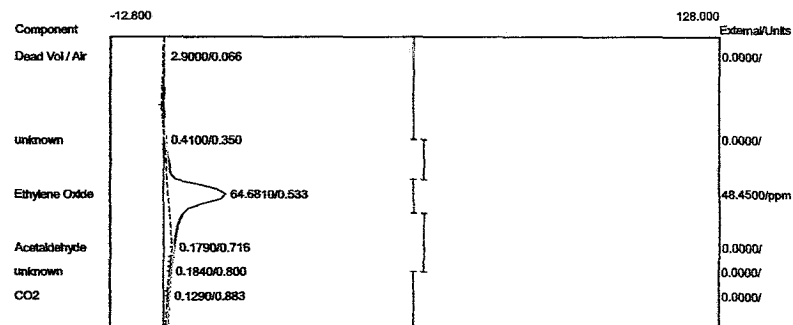
Data file: 2SterAtl-2016-C07.CHR (c:\peak359)

Sample: 48.8 ppm EtO std

Operator: D. Kremer



Component	Retention	Area	External Units
Ethylene Oxide	0.550	10.0020	49.8355 ppm
		10.0020	49.8355



Component	Retention	Area	External Units
Dead Vol / Air	0.066	2.9000	0.0000
Ethylene Oxide	0.533	64.6810	48.4500 ppm
Acetaldehyde	0.716	0.1790	0.0000
CO2	0.883	0.1290	0.0000
		67.8890	48.4500

Lab name: ECSI

Client: Sterigenics - Atlanta

Client ID: PostCal

Analysis date: 03/18/2016 12:36:57

Method: Direct Injection

Description: CHANNEL 1 - FID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

Temp. prog: eto-100.tem

Components: eto1-100.cpt

Data file: 1SterAtl-2016-C08.CHR (c:\peak359)

Sample: 48.8 ppm EtO std

Operator: D. Kremer

Lab name: ECSI

Client: Sterigenics - Atlanta

Client ID: PostCal

Analysis date: 03/18/2016 12:36:57

Method: Direct Injection

Description: CHANNEL 2 - PID

Column: 1% SP-1000, Carbowack B

Carrier: HELIUM

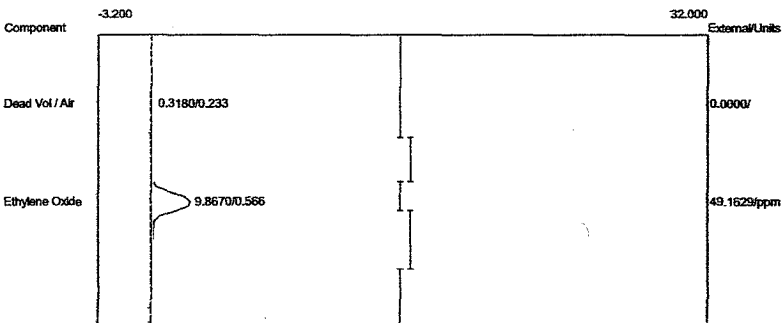
Temp. prog: eto-100.tem

Components: eto2-100.cpt

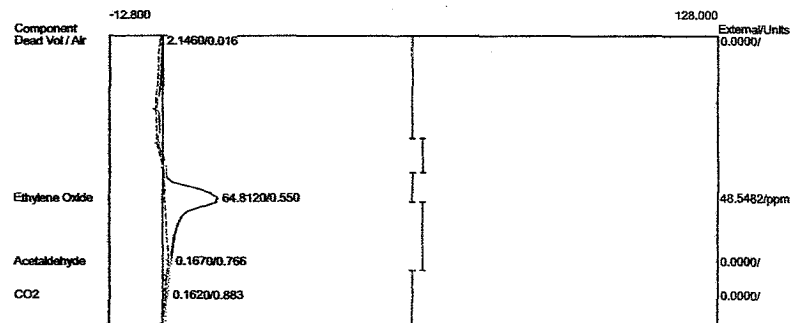
Data file: 2SterAtl-2016-C08.CHR (c:\peak359)

Sample: 48.8 ppm EtO std

Operator: D. Kremer



Component	Retention	Area	External Units
Dead Vol / Air	0.233	0.3180	0.0000
Ethylene Oxide	0.566	9.8670	49.1629 ppm
		10.1850	49.1629

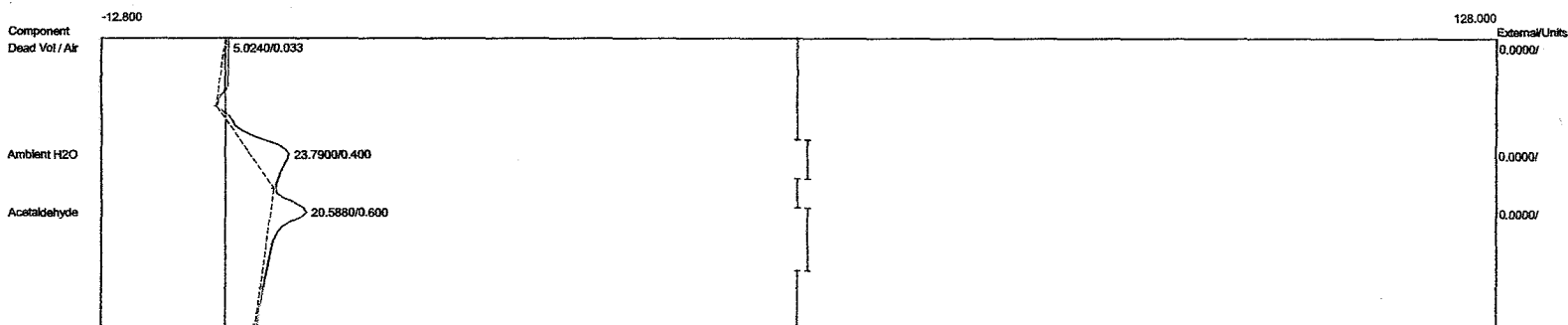


Component	Retention	Area	External Units
Dead Vol / Air	0.016	2.1460	0.0000
Ethylene Oxide	0.550	64.8120	48.5482 ppm
Acetaldehyde	0.766	0.1670	0.0000
CO2	0.883	0.1620	0.0000
		67.2870	48.5482

APPENDIX B

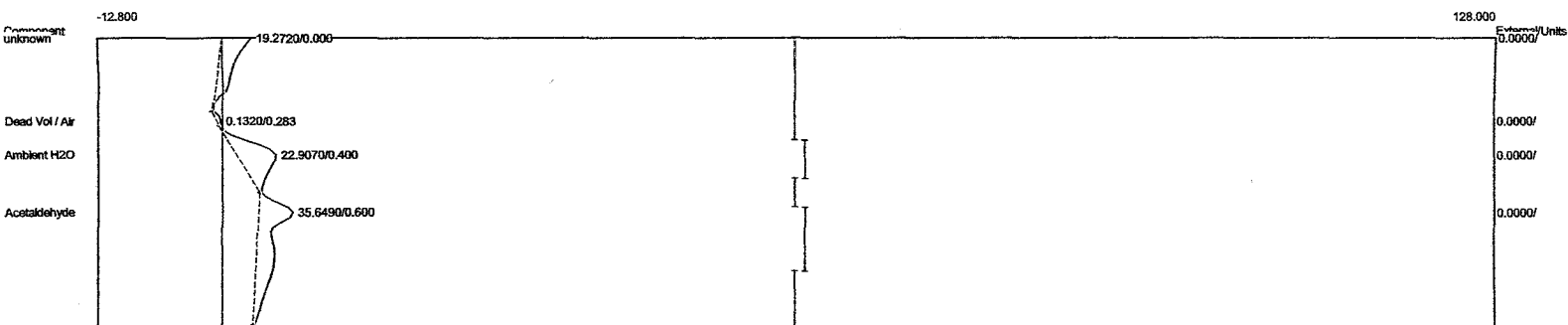
Run#1 Chromatograms

Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:40:36
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAti-2016-1E01.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



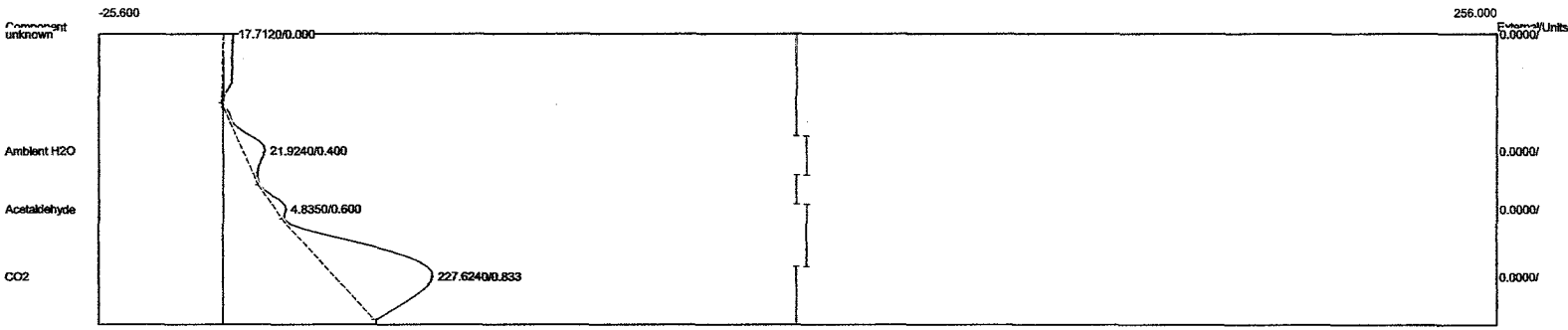
Component	Retention	Area	External Units
Dead Vol / Air	0.033	5.0240	0.0000
Ambient H2O	0.400	23.7900	0.0000
Acetaldehyde	0.600	20.5880	0.0000
		49.4020	0.0000

Lab name: EOC
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:42:26
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E02.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



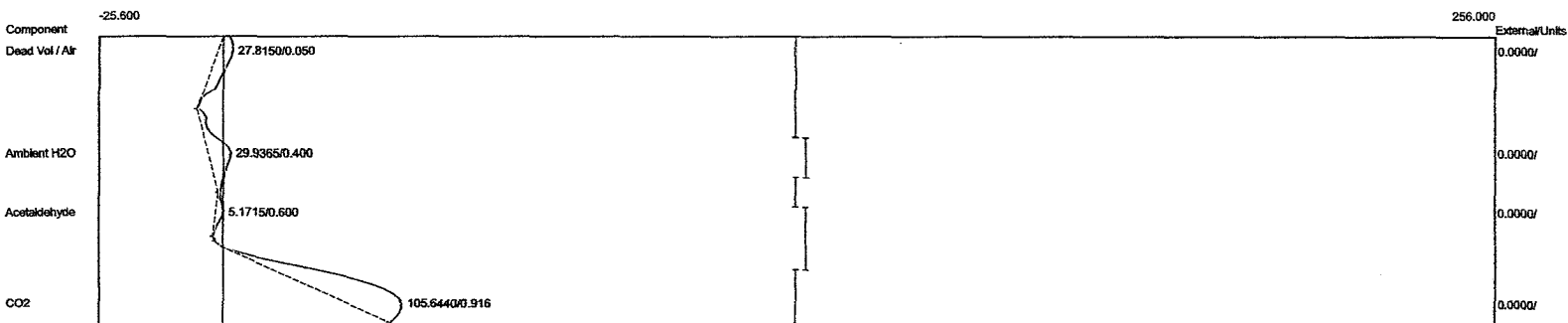
Component	Retention	Area	External	Units
Dead Vol / Air	0.283	0.1320	0.0000	
Ambient H2O	0.400	22.9070	0.0000	
Acetaldehyde	0.600	35.6490	0.0000	
		58.6880	0.0000	

Lab name: ECS
Client: Sterigenics - Atlanta
Client ID: Run#1Exh
Analysis date: 03/17/2016 17:43:40
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAttl-2016-1E03.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



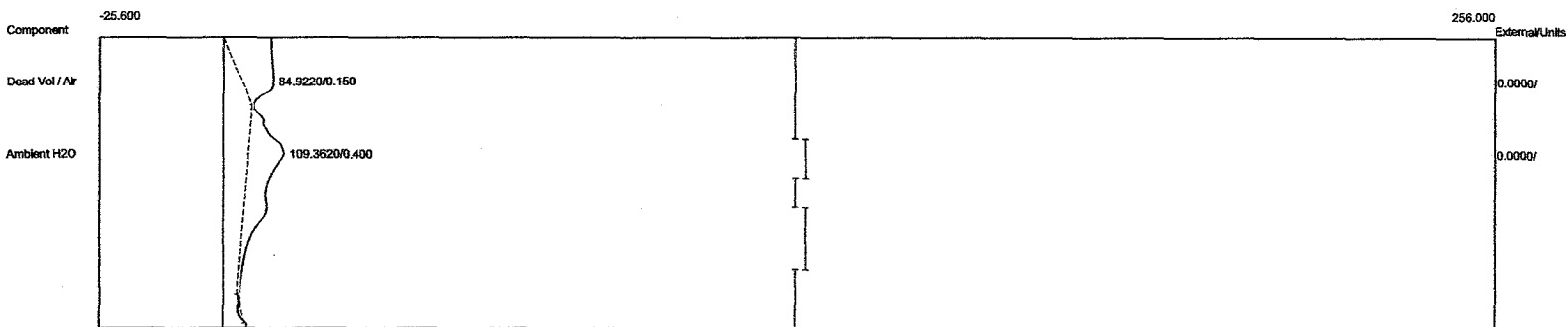
Component	Retention	Area	External	Units
Ambient H2O	0.400	21.9240	0.0000	
Acetaldehyde	0.600	4.8350	0.0000	
CO2	0.833	227.6240	0.0000	
		254.3830	0.0000	

Lab name: 2003
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:45:25
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E04.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



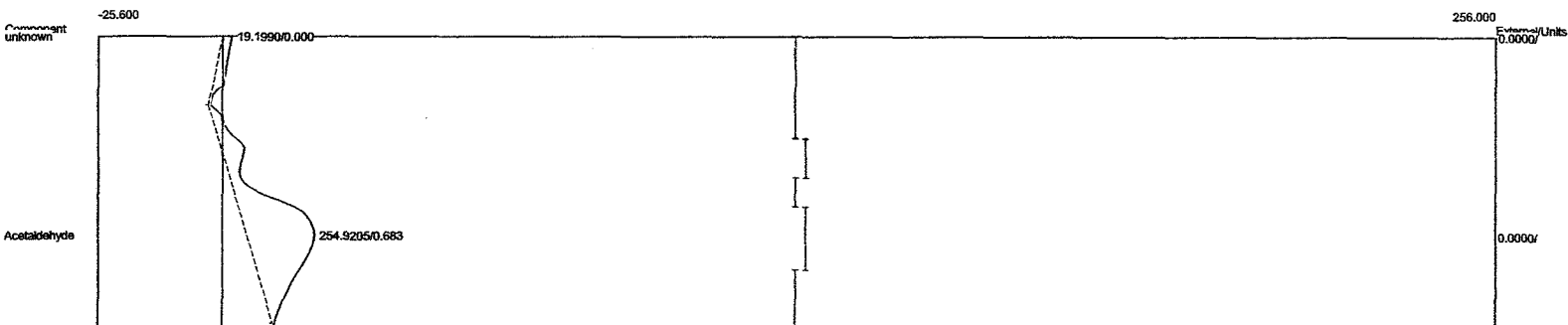
Component	Retention	Area	External	Units
Dead Vol / Air	0.050	27.8150	0.0000	
Ambient H2O	0.400	29.9365	0.0000	
Acetaldehyde	0.600	5.1715	0.0000	
CO2	0.916	105.6440	0.0000	
		168.5670	0.0000	

Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:48:12
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carboxpack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtI-2016-1E05.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



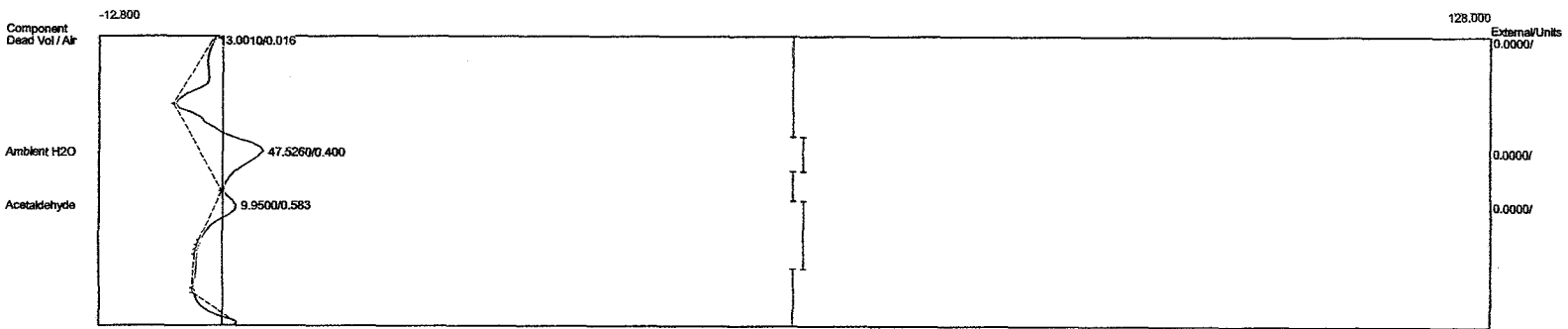
Component	Retention	Area	External Units
Dead Vol / Air	0.150	84.9220	0.0000
Ambient H2O	0.400	109.3620	0.0000
		194.2840	0.0000

Lab name: LCS
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:50:14
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E06.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



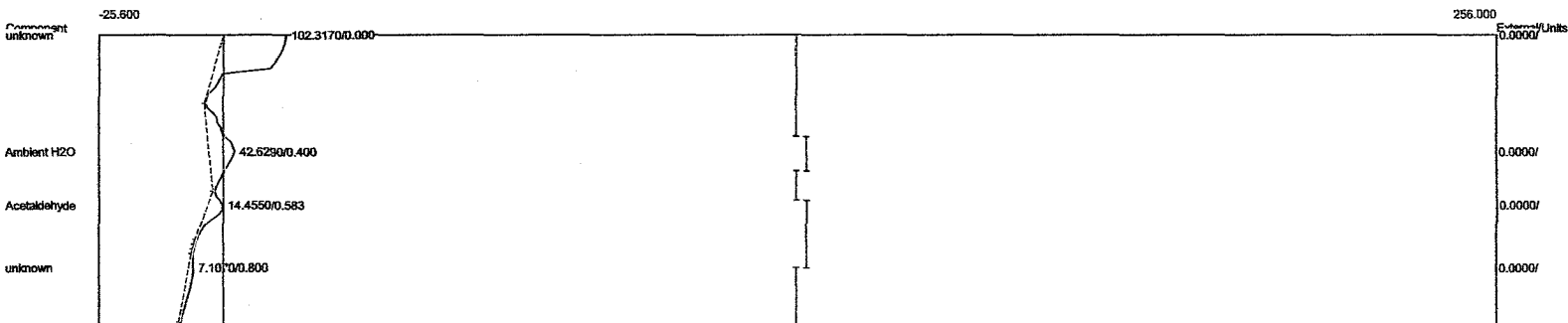
Component	Retention	Area	External Units
Acetaldehyde	0.683	254.9205	0.0000
		254.9205	0.0000

Lab name: EOC
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:53:04
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtI-2016-1E07.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



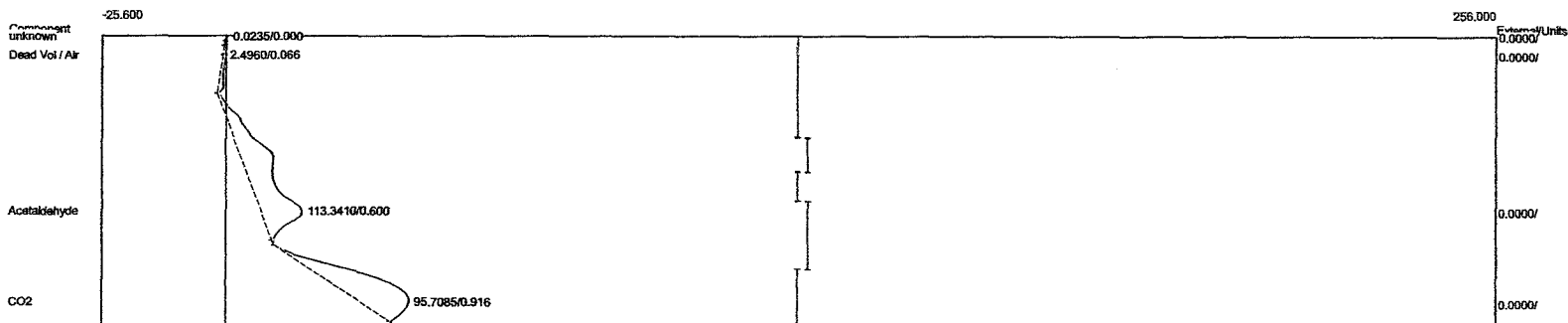
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	13.0010	0.0000	
Ambient H2O	0.400	47.5260	0.0000	
Acetaldehyde	0.583	9.9500	0.0000	
		70.4770	0.0000	

Lab name: E001
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:57:16
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E08.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



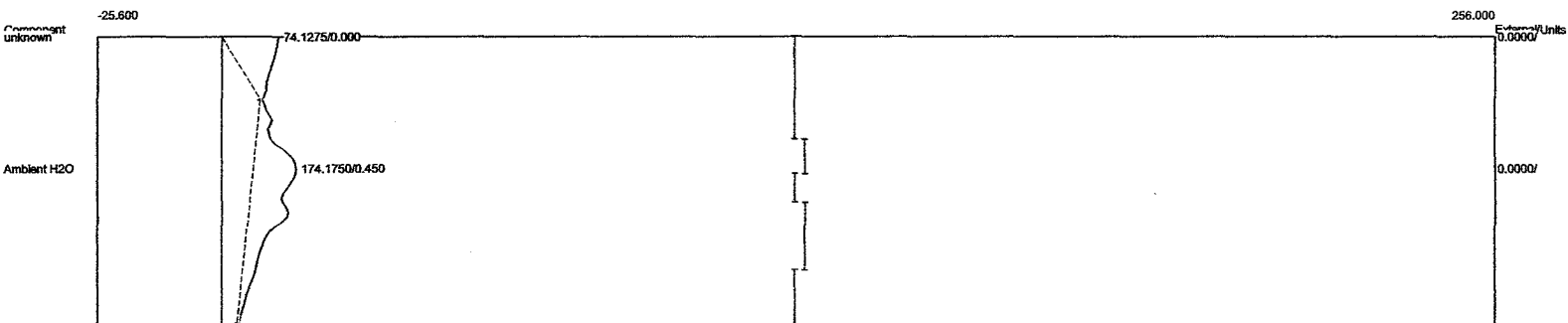
Component	Retention	Area	External	Units
Ambient H2O	0.400	42.6290	0.0000	
Acetaldehyde	0.583	14.4550	0.0000	
		57.0840	0.0000	

Lab name: ECS
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:58:30
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtt-2016-1E09.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



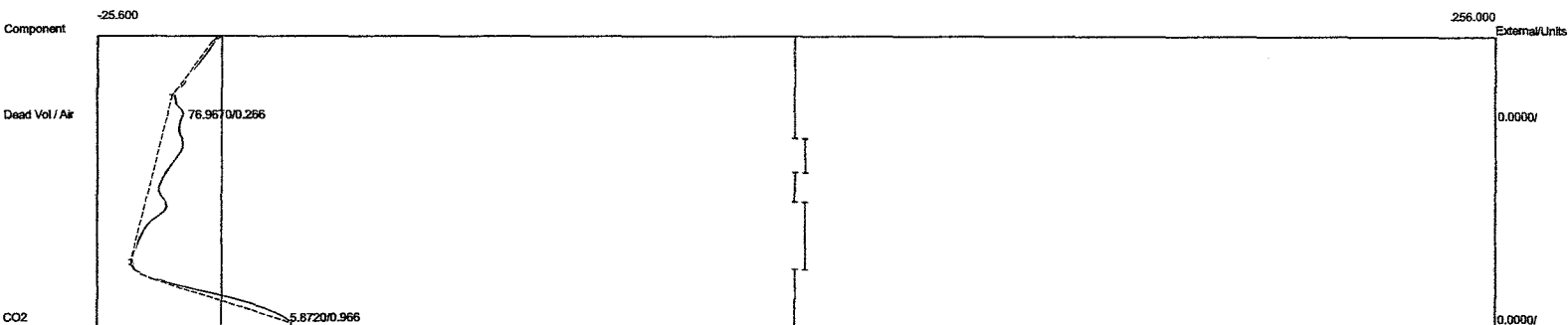
Component	Retention	Area	External	Units
Dead Vol / Air	0.066	2.4960	0.0000	
Acetaldehyde	0.600	113.3410	0.0000	
CO2	0.916	95.7085	0.0000	
		211.5455	0.0000	

Lab name: ECCS
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 17:59:51
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E10.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



Component	Retention	Area	External	Units
Ambient H2O	0.450	174.1750	0.0000	
		174.1750	0.0000	

Lab name: LC01
 Client: Sterigenics - Atlanta
 Client ID: Run#1Exh
 Analysis date: 03/17/2016 18:01:23
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-1E11.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer

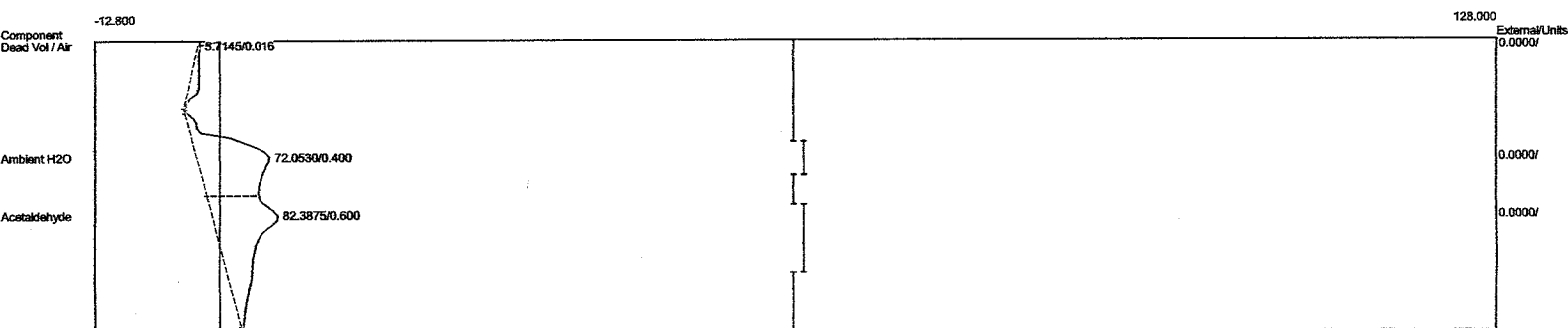


Component	Retention	Area	External	Units
Dead Vol / Air	0.266	76.9670	0.0000	
CO2	0.966	5.8720	0.0000	
		82.8390	0.0000	

APPENDIX C

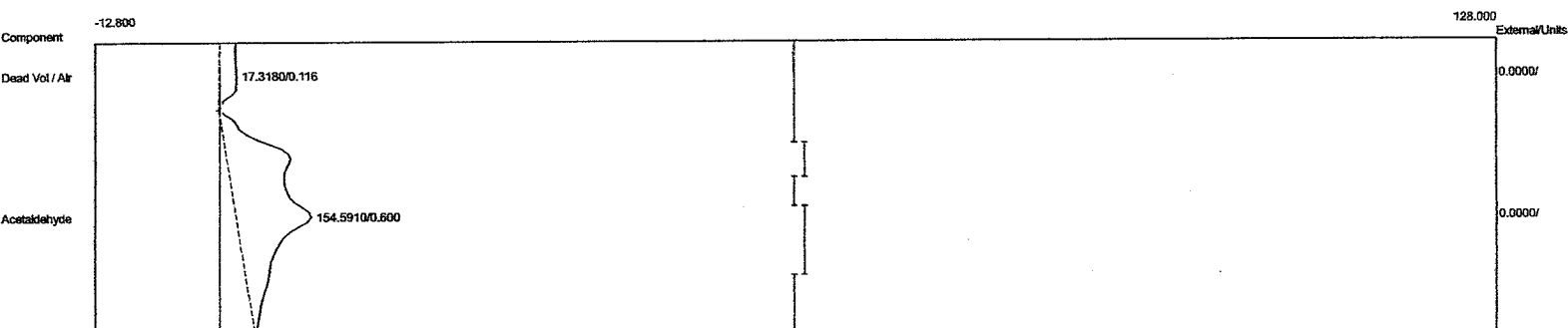
Run#2 Chromatograms

Lab name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:20:04
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carboxpack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E01.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



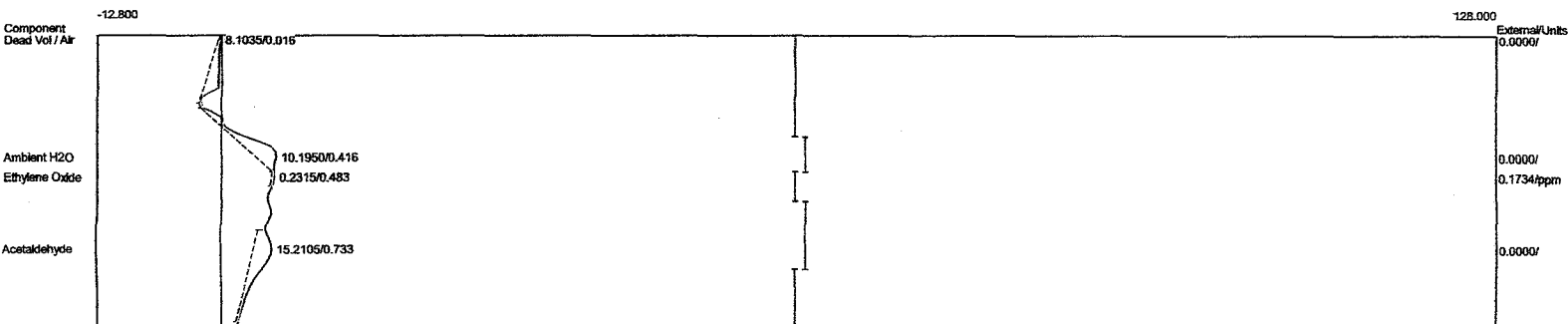
Component	Retention	Area	External Units
Dead Vol / Air	0.016	5.7145	0.0000
Ambient H2O	0.400	72.0530	0.0000
Acetaldehyde	0.600	82.3875	0.0000
		160.1550	0.0000

Lab name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:21:21
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carboxpack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAti-2016-2E02.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



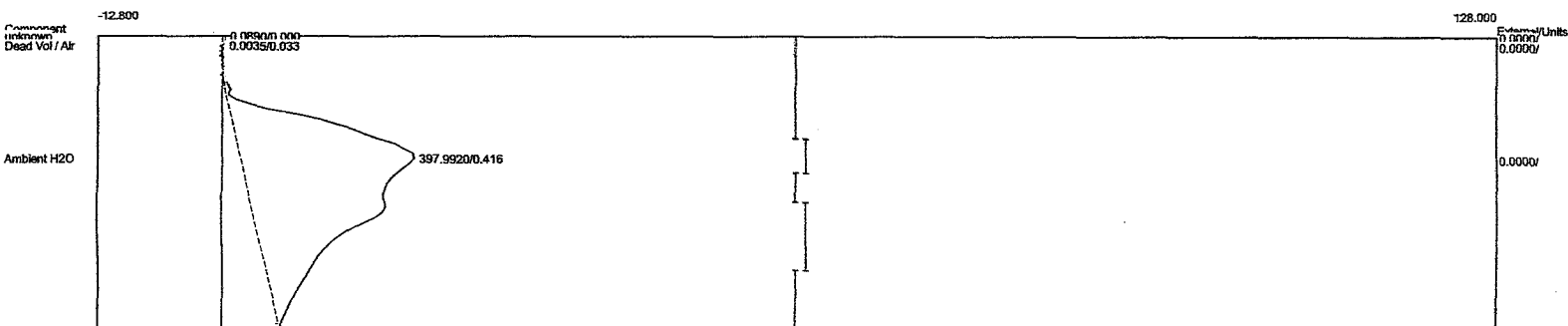
Component	Retention	Area	External Units
Dead Vol / Air	0.116	17.3180	0.0000
Acetaldehyde	0.600	154.5910	0.0000
		171.9090	0.0000

Lab Name: EUSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:22:28
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E03.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



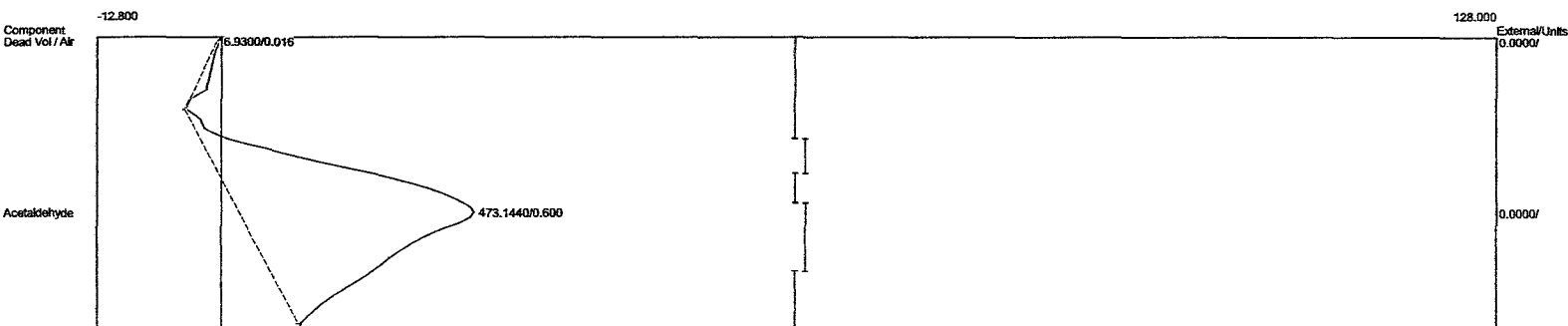
Component	Retention	Area	External Units
Dead Vol / Air	0.016	8.1035	0.0000
Ambient H2O	0.416	10.1950	0.0000
Ethylene Oxide	0.483	0.2315	0.1734 ppm
Acetaldehyde	0.733	15.2105	0.0000
		33.7405	0.1734

Lab name: LCS1
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:23:45
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E04.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



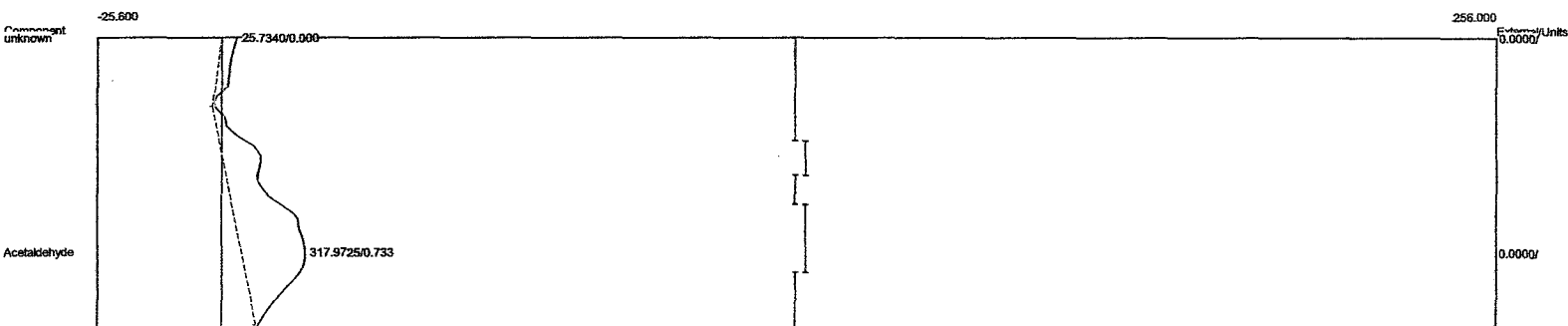
Component	Retention	Area	External Units
Dead Vol / Air	0.033	0.0035	0.0000
Ambient H2O	0.416	397.9920	0.0000
		397.9955	0.0000

Lab name: ECSR
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:24:48
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E05.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



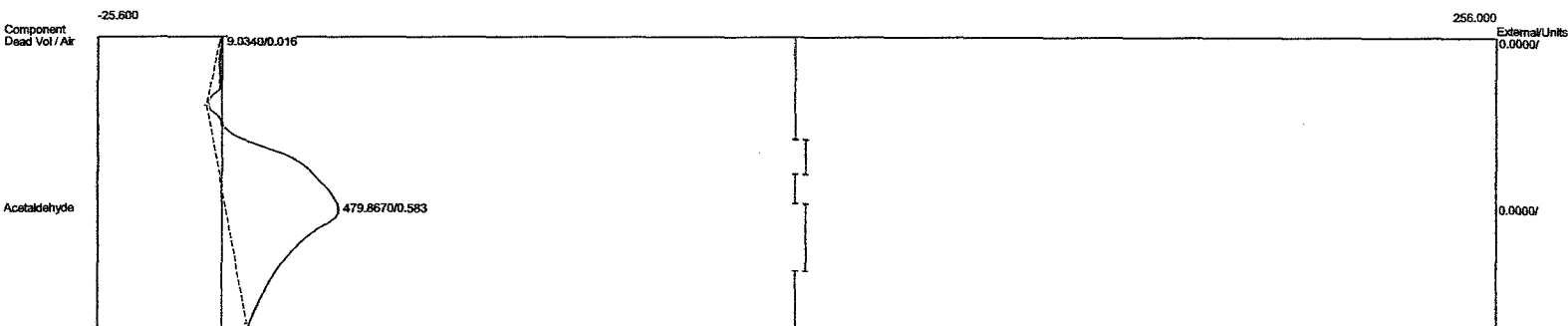
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	6.9300	0.0000	
Acetaldehyde	0.600	473.1440	0.0000	
		480.0740	0.0000	

Lab name: ECSF
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:27:04
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E06.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



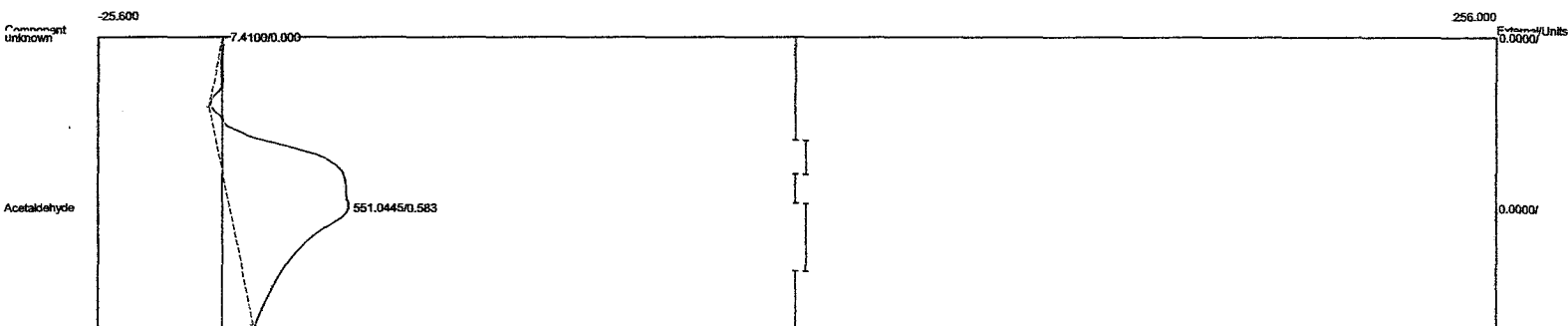
Component	Retention	Area	External Units
Acetaldehyde	0.733	317.9725	0.0000
		317.9725	0.0000

Lab name: ECS
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:28:19
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E07.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



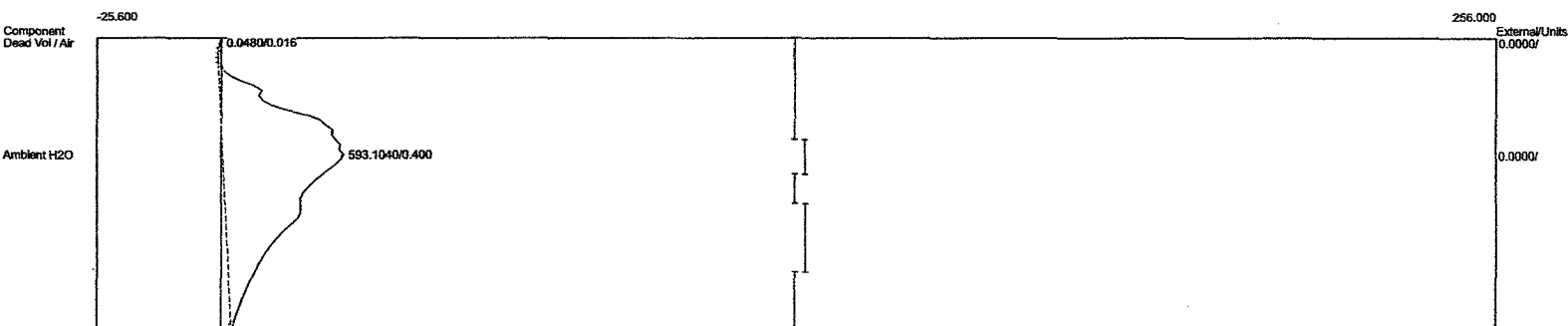
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	9.0340	0.0000	
Acetaldehyde	0.583	479.8670	0.0000	
		488.9010	0.0000	

Lab name: LCCS
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:29:33
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E08.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



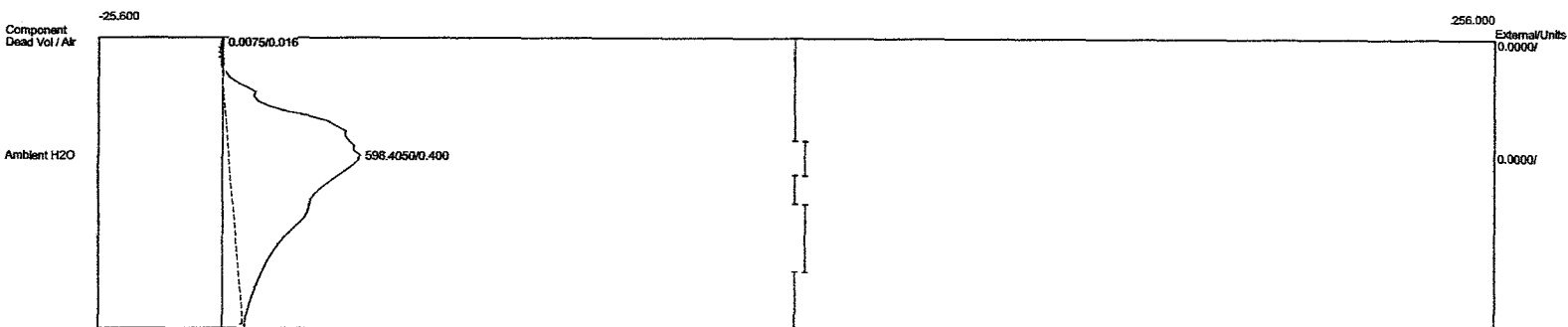
Component	Retention	Area	External Units
Acetaldehyde	0.583	551.0445	0.0000
		551.0445	0.0000

Lab Name: EOC
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:30:48
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E09.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



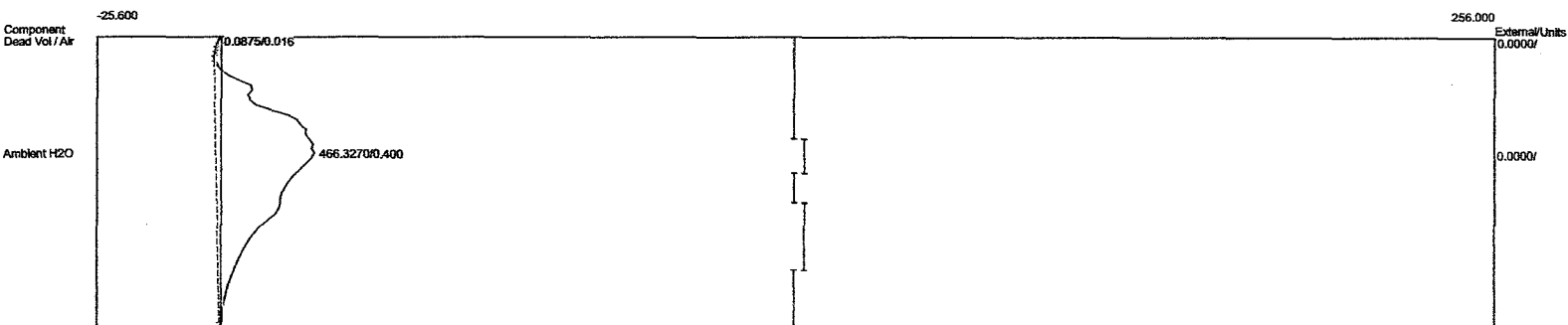
Component	Retention	Area	External Units
Dead Vol / Air	0.016	0.0480	0.0000
Ambient H2O	0.400	593.1040	0.0000
		593.1520	0.0000

Lab name: LCS
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:32:01
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E10.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



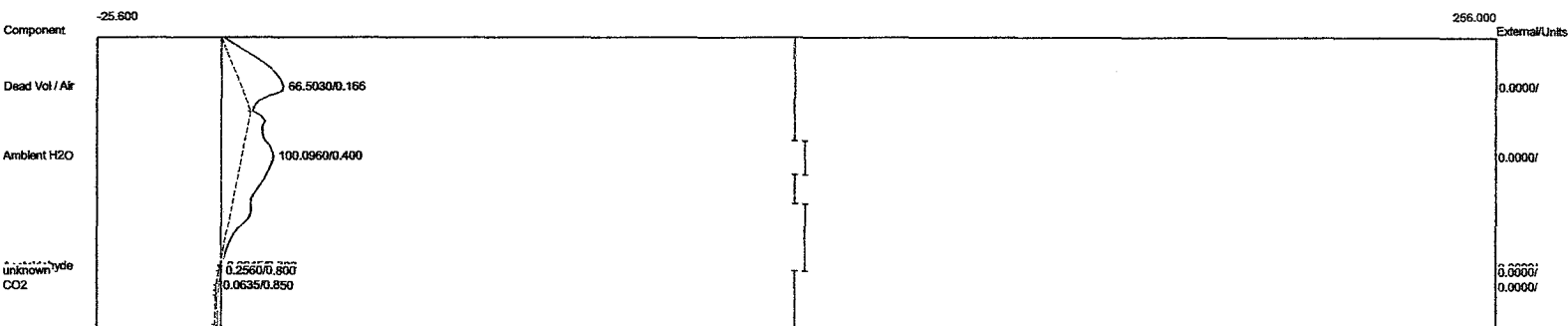
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	0.0075	0.0000	
Ambient H2O	0.400	598.4050	0.0000	
		598.4125	0.0000	

Lab Name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:33:17
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E11.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



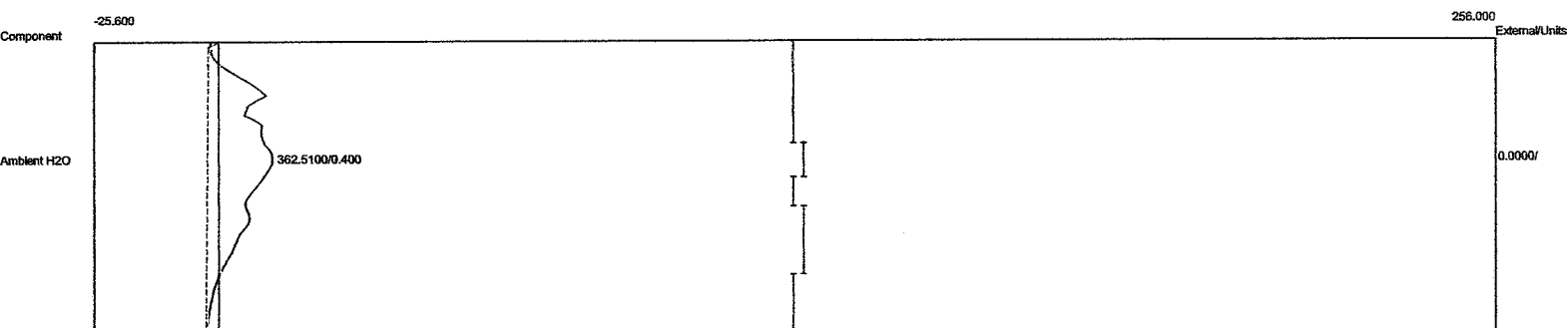
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	0.0875	0.0000	
Ambient H2O	0.400	466.3270	0.0000	
		466.4145	0.0000	

Lab name: ECS
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:34:40
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAti-2016-2E12.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



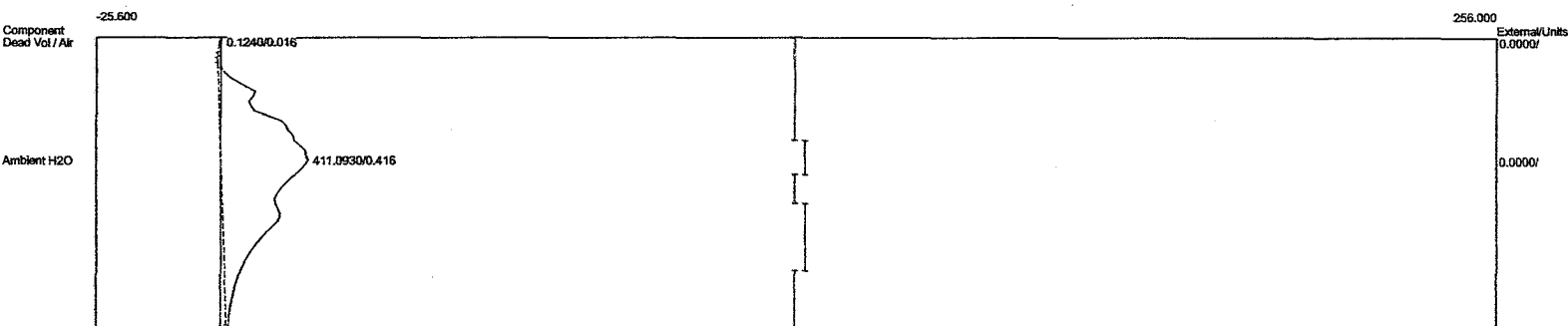
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	66.5030	0.0000	
Ambient H2O	0.400	100.0960	0.0000	
Acetaldehyde	0.783	0.0945	0.0000	
CO2	0.850	0.0635	0.0000	
		166.7570	0.0000	

Lab name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:35:50
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAti-2016-2E13.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



Component	Retention	Area	External	Units
Ambient H2O	0.400	362.5100	0.0000	
		362.5100	0.0000	

Lab name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#2Exh
 Analysis date: 03/18/2016 11:37:03
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-2E14.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer

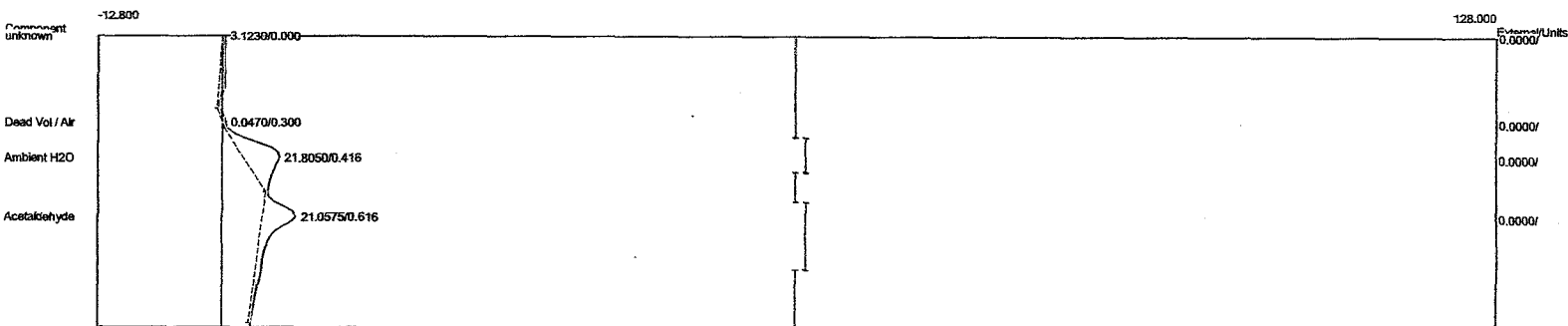


Component	Retention	Area	External Units
Dead Vol / Air	0.016	0.1240	0.0000
Ambient H2O	0.416	411.0930	0.0000
		411.2170	0.0000

APPENDIX D

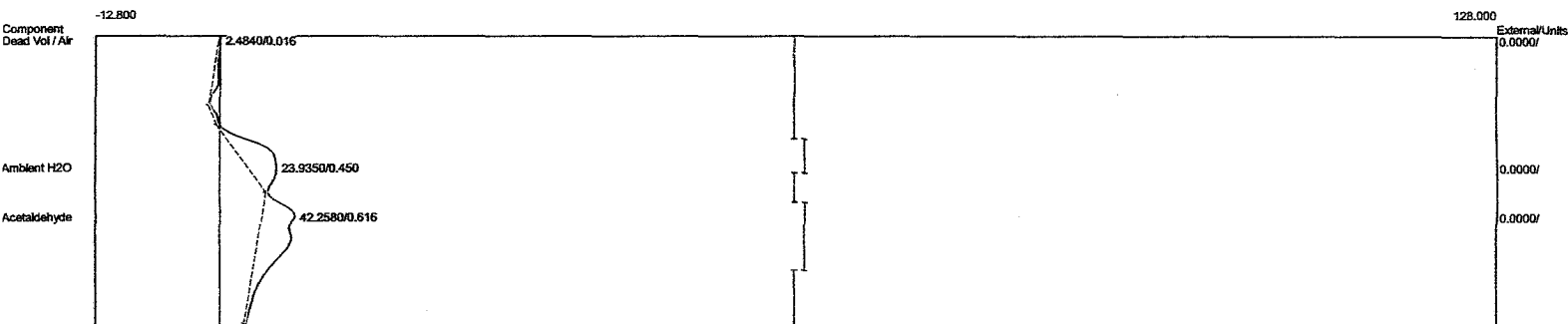
Run#3 Chromatograms

Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:04:38
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E01.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



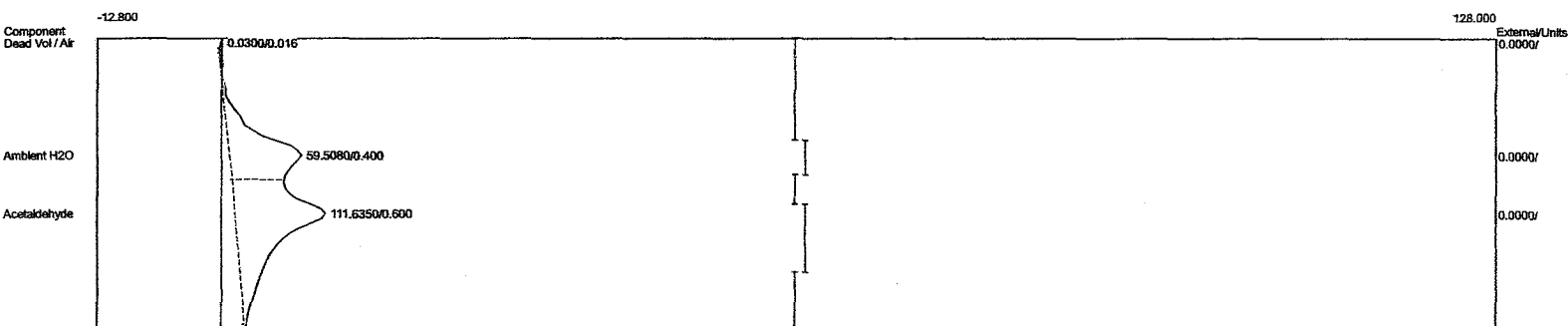
Component	Retention	Area	External	Units
Dead Vol / Air	0.300	0.0470	0.0000	
Ambient H2O	0.416	21.8050	0.0000	
Acetaldehyde	0.616	21.0575	0.0000	
		42.9095	0.0000	

Lab name: LCSI
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:05:47
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E02.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



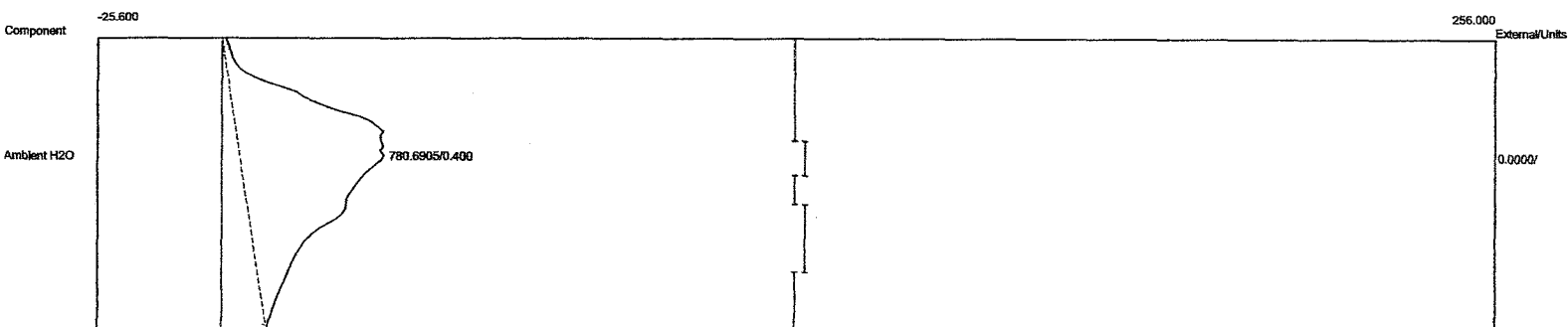
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	2.4840	0.0000	
Ambient H2O	0.450	23.9350	0.0000	
Acetaldehyde	0.616	42.2580	0.0000	
		68.6770	0.0000	

Lab name: E031
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:07:02
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E03.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



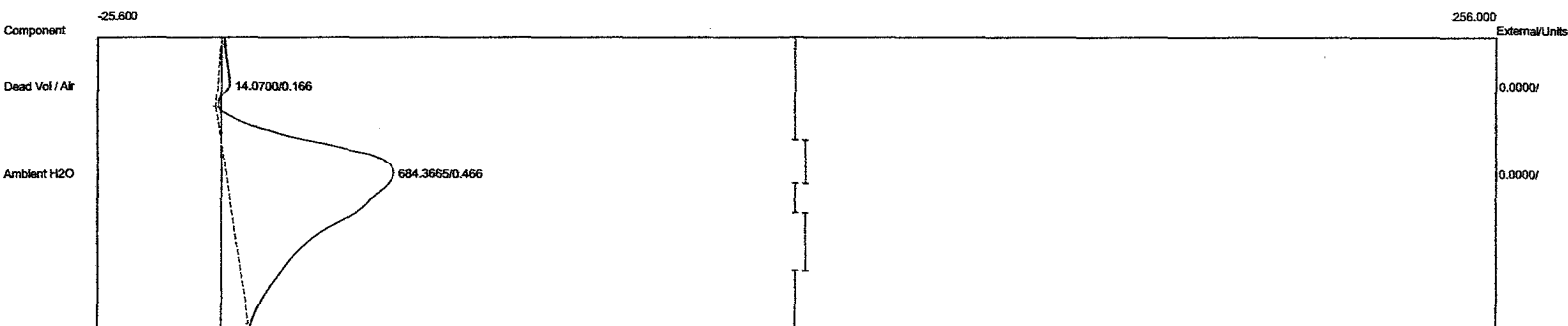
Component	Retention	Area	External	Units
Dead Vol / Air	0.016	0.0300	0.0000	
Ambient H2O	0.400	59.5080	0.0000	
Acetaldehyde	0.600	111.6350	0.0000	
		171.1730	0.0000	

Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:08:21
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E04.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



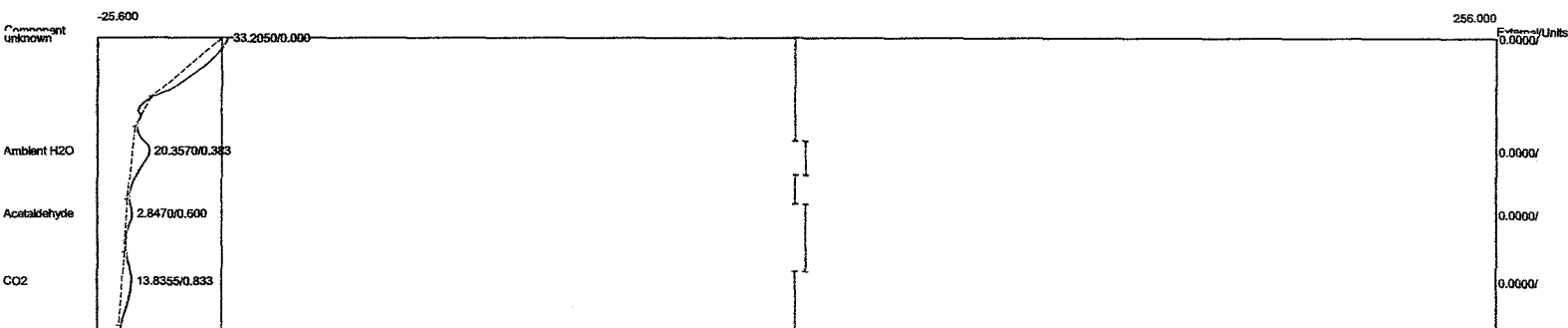
Component	Retention	Area	External	Units
Ambient H2O	0.400	780.6905	0.0000	
		780.6905	0.0000	

Lab name: EOC
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:10:33
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtI-2016-3E05.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



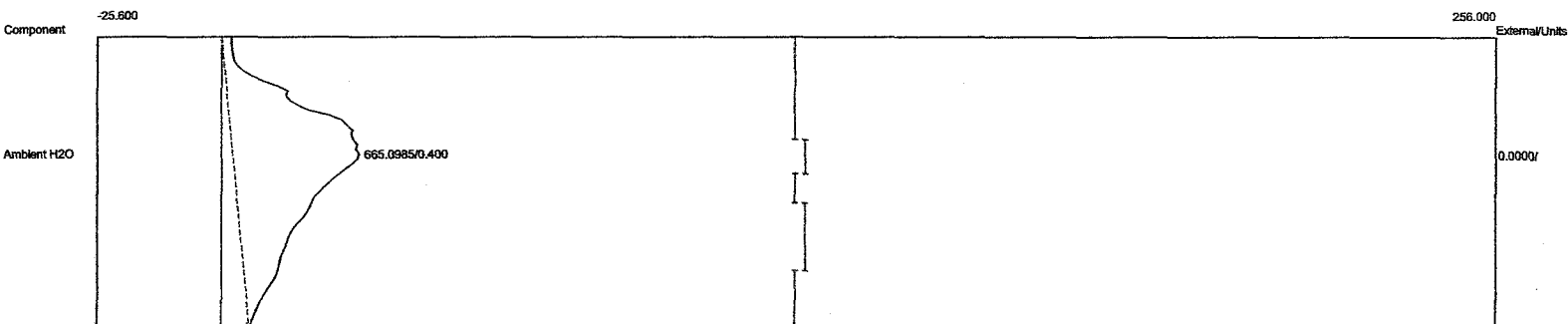
Component	Retention	Area	External Units
Dead Vol / Air	0.166	14.0700	0.0000
Ambient H2O	0.466	684.3665	0.0000
		698.4365	0.0000

Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:12:21
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAti-2016-3E06.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



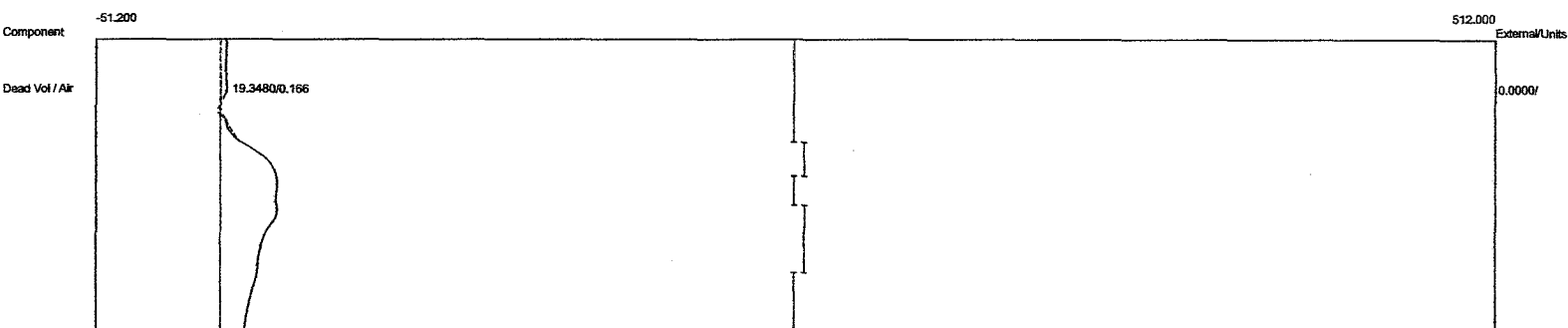
Component	Retention	Area	External Units
Ambient H2O	0.383	20.3570	0.0000
Acetaldehyde	0.600	2.8470	0.0000
CO2	0.833	13.8355	0.0000
		37.0395	0.0000

Lab name: ECS
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:14:17
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E07.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



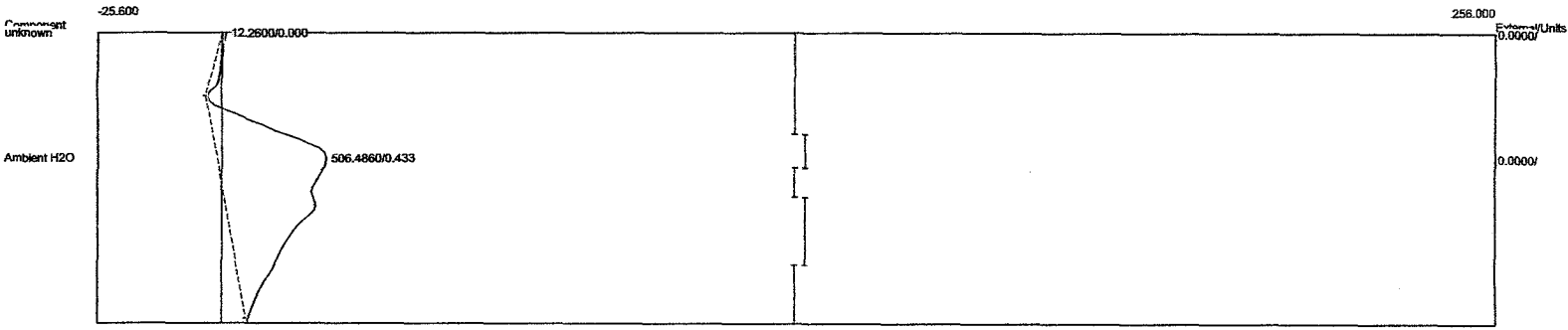
Component	Retention	Area	External	Units
Ambient H2O	0.400	665.0985	0.0000	
		665.0985	0.0000	

Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:15:53
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E08.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



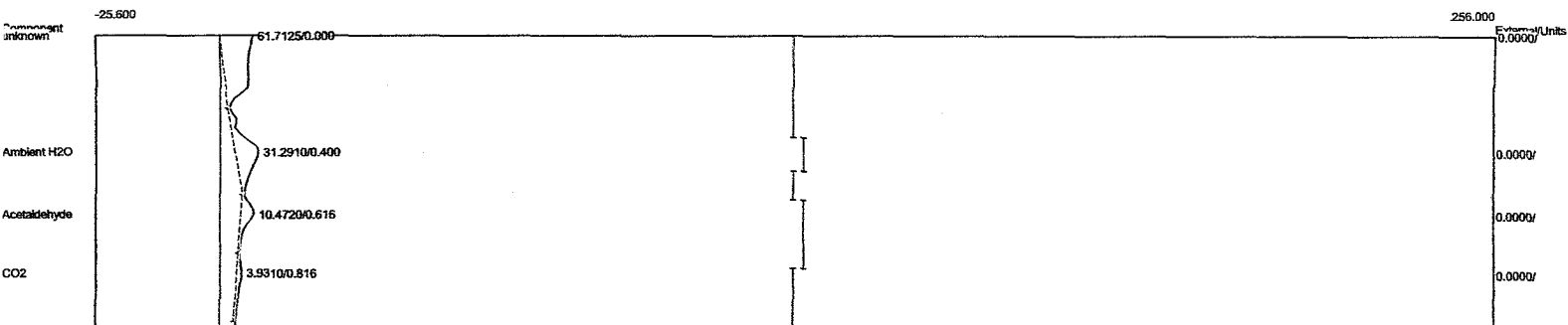
Component	Retention	Area	External	Units
Dead Vol / Air	0.166	19.3480	0.0000	
		19.3480	0.0000	

Lab name: EOC
Client: Sterigenics - Atlanta
Client ID: Run#3Exh
Analysis date: 03/18/2016 12:17:52
Method: Direct Injection
Description: CHANNEL 2 - PID
Column: 1% SP-1000, Carbopack B
Carrier: HELIUM
Temp. prog: eto-100.tem
Components: eto2-100.cpt
Data file: 2SterAtl-2016-3E09.CHR (c:\peak359)
Sample: Ceilcote Scrubber Outlet
Operator: D. Kremer



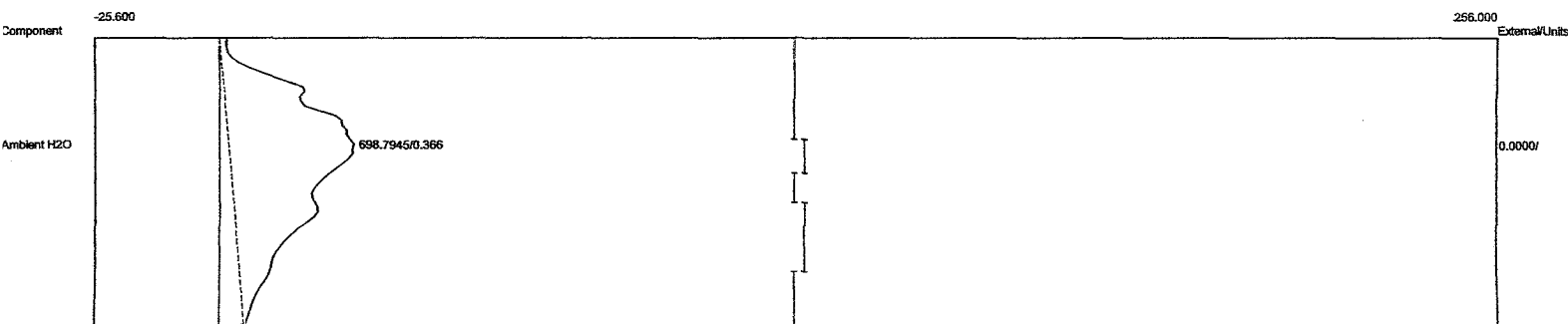
Component	Retention	Area	External	Units
Ambient H2O	0.433	506.4860	0.0000	
		506.4860	0.0000	

Lab Name: EOC
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:20:21
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E10.CHR (c:\peak359)
 Sample: Cellcote Scrubber Outlet
 Operator: D. Kremer



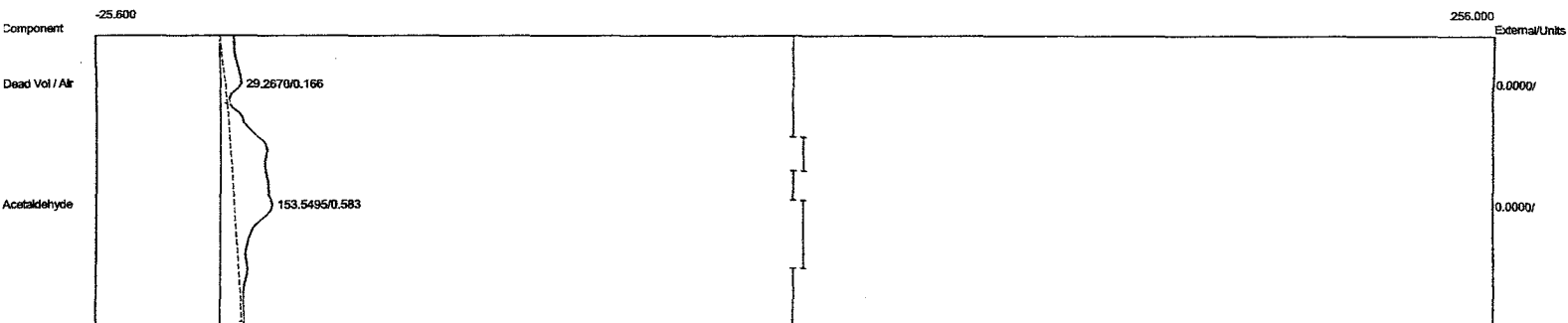
Component	Retention	Area	External	Units
Ambient H2O	0.400	31.2910	0.0000	
Acetaldehyde	0.616	10.4720	0.0000	
CO2	0.816	3.9310	0.0000	
		45.6940	0.0000	

Lab Name: ECSI
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:21:34
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E11.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



Component	Retention	Area	External	Units
Ambient H2O	0.366	698.7945	0.0000	
		698.7945	0.0000	

Lab name: ESCI
 Client: Sterigenics - Atlanta
 Client ID: Run#3Exh
 Analysis date: 03/18/2016 12:22:52
 Method: Direct Injection
 Description: CHANNEL 2 - PID
 Column: 1% SP-1000, Carbopack B
 Carrier: HELIUM
 Temp. prog: eto-100.tem
 Components: eto2-100.cpt
 Data file: 2SterAtl-2016-3E12.CHR (c:\peak359)
 Sample: Ceilcote Scrubber Outlet
 Operator: D. Kremer



Component	Retention	Area	External	Units
Dead Vol / Air	0.166	29.2670	0.0000	
Acetaldehyde	0.583	153.5495	0.0000	
		182.8165	0.0000	

APPENDIX E

Field Data and Calculation Worksheets

ECSi, Inc.

Ethylene Oxide Mass Emissions Data and Calculations

Run #1 (Ceilcote Scrubber Outlet) - Chamber #3

Sterigenics, Inc. - Atlanta, GA

March 17, 2016

<u>DeltaP</u>	<u>SqRtDeltaP</u>	<u>Temp (F)</u>	<u>ppm EtO</u>	1-%H2O =	0.97	
				mw =	28.54	
				stack area =	0.785	
				press =	29.05	
				Tstd =	528	
				Pstd =	29.92	
				Cp =	0.99	
				Kp =	85.49	
				Velocity =	5.6	ft/sec
				Flow =	235	dscfm
				MWeto =	44.05	
				MolVol =	385.32	
				ppmv/ft3 =	1000000	
Average =				EtO Mass Flow =	0.0000003	lbs/min
0.0065	0.0804	93.4	0.010	evac start =	1335	
				evac stop =	1357	
				min/cycle =	24	
				EtO Emissions =	0.0000065	lbs/cycle

INLET CALCULATION:

Pre-Evac:	V =	974	ft3	Post-Evac:	V =	974	ft3
	P =	17.2	in Hg Abs		P =	2.0	in Hg Abs
	T =	130	degF		T =	130	degF
	R =	10.73			R =	10.73	
	mw =	44.05			mw =	44.05	
lbs EtO @ 100% =	57.14	lbs		lbs EtO @ 100% =	6.64	lbs	
				Initial EtO = Scale Wt. =	50.8	lbs	
				% EtO @ Chamber = Scale Wt. / lbs EtO @ 100% (Pre) =	88.9	%	
				Final EtO = % EtO @ Chamber X lbs EtO @ 100% (Post) =	5.9	lbs	
				INLET ETO = Initial EtO - Final EtO =	44.9	lbs	

CONTROL EFFICIENCY = 99.999986 %

Ethylene Oxide Mass Emissions Data and Calculations

Sterigenics, Inc. - Atlanta, GA

				1-%H2O =	0.97	
				mw =	28.54	
				stack area =	0.785	
				press =	29.05	
				Tstd =	528	
				Pstd =	29.92	
				Cp =	0.99	
				Kp =	85.49	
				Velocity =	6.2	ft/sec
				Flow =	262	dscfm
				MWeto =	44.05	
				MolVol =	385.32	
				ppmv/ft3 =	1000000	
				EtO Mass Flow =	0.0000006	lbs/min
				evac start =	1118	
				evac stop =	1140	
				min/cycle =	22	
				EtO Emissions =	0.0000141	lbs/cyc

Pre-Evac:	V =	1469	ft3	Post-Evac:	V =	1469	ft3
	P =	17.3	in Hg Abs		P =	2.0	in Hg Abs
	T =	129	degF		T =	129	degF
	R =	10.73			R =	10.73	
	mw =	44.05			mw =	44.05	
lbs EtO @ 100% =	86.83	lbs		lbs EtO @ 100% =	10.04	lbs	

CONTROL EFFICIENCY = 99.999977 %

ECSi, Inc.

Ethylene Oxide Mass Emissions Data and Calculations

Run #3 (Ceilcote Scrubber Outlet) - Chamber #11

Sterigenics, Inc. - Atlanta, GA

March 18, 2016

<u>DeltaP</u>	<u>SqRtDeltaP</u>	<u>Temp (F)</u>	<u>ppm EtO</u>	1-%H2O =	0.97	
				mw =	28.54	
				stack area =	0.785	
				press =	29.05	
				Tstd =	528	
				Pstd =	29.92	
				Cp =	0.99	
				Kp =	85.49	
				Velocity =	7.9	ft/sec
				Flow =	332	dscfm
				MWeto =	44.05	
				MolVol =	385.32	
				ppmv/ft3 =	1000000	
Average =				EtO Mass Flow =	0.0000004	lbs/min
0.0129	0.1137	95.0	0.0100	evac start =	1203	
				evac stop =	1223	
				min/cycle =	20	
				EtO Emissions =	0.0000076	lbs/cycle

INLET CALCULATION:

Pre-Evac:	V =	5174	ft3	Post-Evac:	V =	5174	ft3
	P =	13.0	in Hg Abs		P =	3.0	in Hg Abs
	T =	132	degF		T =	131	degF
	R =	10.73			R =	10.73	
	mw =	44.05			mw =	44.05	
lbs EtO @ 100% =		228.65	lbs	lbs EtO @ 100% =		52.85	lbs
				Initial EtO = Scale Wt. =	99.0	lbs	
				% EtO @ Chamber = Scale Wt. / lbs EtO @ 100% (Pre) =	43.3	%	
				Final EtO = % EtO @ Chamber X lbs EtO @ 100% (Post) =	22.9	lbs	
				INLET ETO = Initial EtO - Final EtO =	76.1	lbs	

CONTROL EFFICIENCY = 99.999990 %

ECSi - VELOCITY TRAVERSE DATA

Client: Sterigenics, Inc. Run #: 1 Date: 3/17/2016 Port Sketch: _____

Location: Atlanta, Georgia Probe Type: Std. Baro Press: 29.05

Source: Ceilcote Packed Tower Scrubber Outlet Stack I.D.: 12 in. Static Press: -0.01

Port 1								Port 2						
Inches From Port	Point#	Delta P				Stack Temp (F)	Cyclonic Angle	Point#	Delta P				Stack Temp (F)	Cyclonic Angle
		Low	High	Average	Sq Root				Low	High	Average	Sq Root		
0.4	1	0.0025	0.0025	0.0025	0.0500	79	0	1	0.0025	0.0025	0.0025	0.0500	79	0
1.25	2	0.0025	0.005	0.00375	0.0612	79	0	2	0.005	0.005	0.005	0.0707	79	0
2.3	3	0.005	0.0075	0.00625	0.0791	79	0	3	0.005	0.0075	0.00625	0.0791	79	0
3.9	4	0.0075	0.0075	0.0075	0.0866	79	0	4	0.0075	0.01	0.00875	0.0935	80	0
8.1	5	0.0075	0.01	0.00875	0.0935	79	0	5	0.0075	0.0075	0.0075	0.0866	80	0
9.7	6	0.005	0.0075	0.00625	0.0791	79	0	6	0.005	0.0075	0.00625	0.0791	80	0
10.75	7	0.005	0.005	0.005	0.0707	80	0	7	0.0025	0.005	0.00375	0.0612	80	0
11.6	8	0.0025	0.0025	0.0025	0.0500	80	0	8	0.0025	0.0025	0.0025	0.0500	80	0
	9							9						
	10							10						
	11							11						
	12							12						
	13							13						
	14							14						
	15							15						
	16							16						
	17							17						
	18							18						
	19							19						
	20							20						
	21							21						
	22							22						
	23							23						
	24							24						
Average Values:										0.0053	0.0713	79.4	0.0	

ETHYLENE OXIDE SOURCE TEST/CALIBRATION DATA

Client: Sterigenics-Atlanta

Source Tested: Citico scrubber / AA safe cell system Date: 3/17/16
3/18/16

PRE CALIBRATION

	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
Inlet (FID)	Area Counts #1	23	199	19.1					
	Area Counts #2	22	202	19.6					
	Average Area	23	2.01	19.4					
	Audit Standard (48.8 ppmv) Result <u>498</u> ✓								
Outlet (PID)	Area Counts #1	1.54	13.1	126					
	Area Counts #2	1.57	13.4	128					
	Average Area	1.56	13.3	127					
	Audit Standard (48.8 ppmv) Result <u>48.5</u> ✓								

Exhaust ~~Backvent~~ ~~Start~~ ~~Stop~~
 Run #1 1739 1803
 Run #2 1118 1140
 Run #3 1203 1223
 Backvent ~~Start~~ ~~Stop~~
 Run #1 2229 2335
 Run #2 2253 2308
 Run #3 2310 2325
 Ch. 3 Ch. 8 Ch. 11 Ch. 11 Ch. 10 Ch. 7

P_{bar}: 29.05
 %H₂O: 3

EtO Usage (lbs/yr): —
 Cycles Per Week: —

POST CALIBRATION

	Calibration Gas Conc. (ppmv)	1.10 ppm EtO	10.1 ppm EtO	100 ppm EtO	1000 ppm EtO	10080 ppm EtO			
Inlet (FID)	Area Counts #1								
	Area Counts #2								
	Average Area								
	Audit Standard (48.8 ppmv) Result								
Outlet (PID)	Area Counts #1								
	Area Counts #2								
	Average Area								
	Audit Standard (48.8 ppmv) Result								

ECSi

APPENDIX F
Gas Certifications



Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information

Project No.: 02-57164-001
Item No.: 02020001310TCL
P.O. No.: VBL-D KREMER

Cylinder Number: CAL4448
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name

ETHYLENE OXIDE
NITROGEN

**Concentration
(Moles)**

1.10 PPM
BALANCE

**Accuracy
(+/-%)**

5

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY:


MT

DATE: 4-14-14



Scott Specialty Gases

2500 CAJON BLVD., SAN BERNARDINO, CA 92411

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information

Project No.: 02-57164-003
Item No.: 02020001320TCL
P.O. No.: VBL - D. KREMER

Cylinder Number: CLM003232
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name

ETHYLENE OXIDE
NITROGEN

**Concentration
(Moles)**

10.1 PPM
BALANCE

**Accuracy
(+/-%)**

5

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY:

MT

DATE: 4-14-14



Scott Specialty Gases

2800 CAJON BLVD., SAN BERNARDINO, CA 92411

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Phone: 909-887-2571 Fax: 909 887 0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information

Project No.: 02-57184-004
Item No.: 02020001330TCL
P.O. No.: VBL - D. KREMER

Cylinder Number: CLM011385
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name

ETHYLENE OXIDE
NITROGEN

**Concentration
(Moles)**

100. PPM
BALANCE

**Accuracy
(+/-%)**

5

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY:

B. McCall
BLM

DATE: 4-14-14



Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Phone: 909 887 2571 Fax: 909-887-0649

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information

Project No.: 02-57164-005
Item No.: 02020001340TCL
P.O. No.: VBL-D. KREMER

Cylinder Number: CLM002810
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

Component Name

ETHYLENE OXIDE
NITROGEN

Concentration
(Moles)

1.000. PPM
BALANCE

Accuracy
(+/-%)

5

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY:


BLM

DATE: 4-14-14



Scott Specialty Gases

2600 CAJON BLVD., SAN BERNARDINO, CA 92411

CERTIFIED WORKING CLASS

Single-Certified Calibration Standard

Phone: 909-887-2571 Fax: 909-887-0549

CERTIFICATE OF ACCURACY: Certified Working Class Calibration Standard

Product Information

Project No.: 02-57164-006
Item No.: 02020001340TCL
P.O. No.: VBL-D. KREMER

Cylinder Number: CLM005787
Cylinder Size: CL
Certification Date: 14Apr2014

Customer

ECSI, INC
PO BOX 848
SAN CLEMENTE, CA 92672

CERTIFIED CONCENTRATION

<u>Component Name</u>	<u>Concentration (Moles)</u>	<u>Accuracy (+/-%)</u>
ETHYLENE OXIDE NITROGEN	10,080. PPM BALANCE	5

TRACEABILITY

Traceable To

Scott Reference Standard

APPROVED BY:

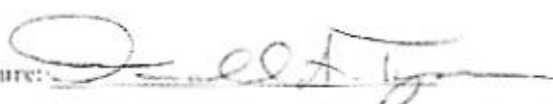
BLM

DATE: 4-14-14

CERTIFICATE OF ANALYSIS

Customer Name:	ECSI, Inc.	Cylinder Number:	SA25925
Stock or Analyzer Tag Number:	N/A	Product Class:	Certified Standard
Customer Reference:	Verbal- Dan	Cylinder - Contents¹:	28 CF @ 2000 PSI
MESA Reference:	104448	Cylinder-CGA:	A006-11P-BR 350
Date of Certification:	4/15/2014	Analysis Method:	GC-TCD FID
Recommended Shelf Life:	2 Years	Preparation Method:	Gravimetric

Component	Requested Concentration ²	Reported Concentration ^{2,3}
Ethylene Oxide	50 ppm	48.8 ppm
Nitrogen	Balance	Balance

Authorized Signature: 

- The fill pressure shown on the CTA is as originally quoted. The fill pressure measured by the customer may differ from the fill pressure originally quoted due to temperature effects, compressibility of the individual components when blended together in the cylinder, gauge accuracy or reduction in content volume before shipping as a result of samples withdrawn for laboratory use, necessary to ensure product quality.
- Unless otherwise stated, concentrations are given in molar units.
- Vapor pressure mixes are blended at a sufficiently low pressure so as to eliminate phase separation under most low temperature conditions encountered during transport or storage. However, it is generally recommended that cylinders containing vapor pressure restricted mixes be placed on the floor in a horizontal position and rolled back and forth to improve homogeneity of the gas phase mixture before being put into service.

Analytical Gas Standards are prepared and analyzed using combinations of NIST traceable weights, NISTs provided by NIST, and internal gas standards that have been verified for accuracy using procedures published by the US-EPA. Pure gases are analyzed and certified for purity using minor component Analytical Gas Standards prepared according to the methods specified above. Balances are calibrated to NIST test weights covered by NIST test number 822.356178.06. Reference Certification #s: 163 W, 830 N and 3260. Calibration methods are in conformance with NIST 881145662A.

MESA Specialty Gases & Equipment

division of MESA International Technologies, Inc.
3619 Pendleton Avenue, Suite C • Santa Ana, California 92704 • USA
TEL: 714-434-7102 • FAX: 714-434-8006 • E-mail: mail@mesagas.com
On-line Catalog at: www.mesagas.com

APPENDIX G

Process/Parametric Monitoring Data

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP- GAS	ALARMS & MESSAGES				ACTION TAKEN			
20:14	13.6	131		153								
20:16	15.7	131		155								
20:17	17.2	131		157								
MAX:	17.2	131		167	PHASE 0:13				PHASE ELAPSED 0:13			
MIN:	3.5	130		143					CYCLE 1:11			
20:18	OPERATOR SENSOR CHECK -- PR 58.2, RH 0, JWT 130, VLT 103, VGX 158											
	CT1 131,	CT2 131,	CT3 130,	P01 130,	P02 FAIL,	P03 FAIL,	P04 81					
	P05 81,	P06 81,	P07 81,	P08 81,	P09 81,	P10 81,	P11 81					
	P12 81,	P13 81,	P14 81,	P15 81,	P16 81,	P17 81,	P18 81					
	P19 81,	P20 81,	ETO 0,	H2O 0.1,	WT 453.4							

STERILANT USED THIS PHASE: 50.8. CYCLE TOTAL: 50.8

GAS DWELL (ED) PHASE

20:18	17.2	131	158
20:20	17.1	130	157
20:22	17.1	130	156
20:24	17.1	130	154
20:26	17.1	130	153
20:28	OPERATOR SENSOR CHECK -- PR 58.0, RH 0, JWT 130, VLT 101, VGX 152		
	CT1 130,	CT2 130,	CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81
	P05 81,	P06 81,	P07 81, P08 81, P09 81, P10 81, P11 81
	P12 81,	P13 81,	P14 81, P15 81, P16 81, P17 81, P18 81
	P19 81,	P20 81,	ETO 0, H2O 0.1, WT 453.4
20:28	17.1	130	151
20:30	17.1	130	150
20:32	17.1	130	149
20:34	17.1	130	147
20:36	17.1	130	146
20:38	OPERATOR SENSOR CHECK -- PR 58.0, RH 0, JWT 130, VLT 100, VGX 145		
	CT1 130,	CT2 130,	CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81
	P05 81,	P06 81,	P07 81, P08 81, P09 81, P10 81, P11 81
	P12 81,	P13 81,	P14 81, P15 81, P16 81, P17 81, P18 81
	P19 81,	P20 81,	ETO 0, H2O 0.1, WT 453.5
20:38	17.1	130	145
20:40	17.1	130	144
20:41	17.1	130	143
20:41	OPERATOR SENSOR CHECK -- PR 58.0, RH 0, JWT 130, VLT 100, VGX 143		
	CT1 130,	CT2 130,	CT3 130, P01 130, P02 FAIL, P03 FAIL, P04 81
	P05 81,	P06 81,	P07 81, P08 81, P09 81, P10 81, P11 81
	P12 81,	P13 81,	P14 81, P15 81, P16 81, P17 81, P18 81
	P19 81,	P20 81,	ETO 0, H2O 0.1, WT 453.5
20:41	'KLS		
20:42	17.1	130	143
20:44	17.1	130	141
20:46	17.1	130	140
20:48	17.1	130	139

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
------	----------------	---------------------	---------	------------	-------------------	--------------

HUMIDIFICATION (PRESSURE) PHASE

14:15	2.0	131		112		
14:16	3.5	131		112		
MAX:	3.5	131		112	PHASE 0:00	PHASE ELAPSED 0:00
MIN:	2.0	131		112		CYCLE 0:37

HUMIDITY DWELL (PRESS) PHASE

14:16	3.6	131		112		
14:18	3.8	131		112		
14:20	3.8	130		111		
14:22	3.8	129		110		
14:24	3.8	128		109		
14:26	3.8	128		108		
14:26	3.5	128		108		
MAX:	3.8	131		112	PHASE 0:10	PHASE ELAPSED 0:10
MIN:	3.5	128		108		CYCLE 0:47

GAS A (EO) PHASE

14:26	3.5	128		108	===== STERILANT 1 =====									
14:28	5.5	128		107										
14:30	OPERATOR SENSOR CHECK --				PR	25.6,	RH	0,	JWT	134,	VLT	83,	VGX	107
	CT1	128,	CT2	128,	CT3	129,	P01	127,	P02	FAIL,	P03	FAIL,	P04	83
	P05	83,	P06	83,	P07	83,	P08	83,	P09	83,	P10	83,	P11	83
	P12	83,	P13	83,	P14	83,	P15	83,	P16	83,	P17	83,	P18	83
	P19	83,	P20	83,	ETO	0,	H2O	0.1,	WT	482.0				
14:30	'KLS													
14:30	7.5	128		107										
14:32	9.5	129		107										
14:34	11.5	129		106										
14:36	13.6	130		106										
14:38	15.5	130		106										
14:39	17.2	129		106										
MAX:	17.2	130		108	PHASE 0:13	PHASE ELAPSED 0:13								
MIN:	3.5	128		106		CYCLE 1:00								

STERILANT USED THIS PHASE: 70.0, CYCLE TOTAL: 70.0

GAS DWELL (EO) PHASE

14:40	17.1	129		106
14:42	17.1	128		107
14:44	17.2	128		108
14:46	17.2	128		108

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES						ACTION TAKEN			
14:48	OPERATOR SENSOR CHECK --				PR	58.2,	RH	0,	JWT	144,	VLT	83,	VGX	109
	CT1	128,	CT2	130,	CT3	128,	P01	129,	P02	FAIL,	P03	FAIL,	P04	83
	P05	83,	P06	83,	P07	83,	P08	83,	P09	83,	P10	83,	P11	83
	P12	83,	P13	83,	P14	83,	P15	83,	P16	83,	P17	83,	P18	83
	P19	83,	P20	83,	ETO	0,	H2O	0.1,	WT	433.0				
14:48	'WJ													
14:48	17.2	129		109										
14:50	17.2	129		110										
14:52	17.2	130		111										
14:54	17.2	130		112										
14:56	17.2	130		113										
14:58	17.2	130		114										
15:00	17.2	130		114										
15:02	17.3	130		115										
15:04	17.3	129		115										
15:06	17.3	129		116										
15:08	17.3	129		116										
15:08	17.3	129		116										
15:08	OPERATOR SENSOR CHECK --				PR	58.5,	RH	0,	JWT	133,	VLT	83,	VGX	116
	CT1	128,	CT2	130,	CT3	129,	P01	129,	P02	FAIL,	P03	FAIL,	P04	83
	P05	83,	P06	83,	P07	83,	P08	83,	P09	83,	P10	83,	P11	83
	P12	83,	P13	83,	P14	83,	P15	83,	P16	83,	P17	83,	P18	83
	P19	83,	P20	83,	ETO	0,	H2O	0.1,	WT	433.0				
15:09	'KLS													
15:10	17.3	129		116										
15:12	17.3	129		117										
15:14	17.3	129		117										
15:15	17.3	129		117	LONG EXPOSURE									
15:15	OPERATOR SENSOR CHECK --				PR	58.5,	RH	0,	JWT	143,	VLT	83,	VGX	117
	CT1	128,	CT2	130,	CT3	129,	P01	129,	P02	FAIL,	P03	FAIL,	P04	83
	P05	83,	P06	83,	P07	83,	P08	83,	P09	83,	P10	83,	P11	83
	P12	83,	P13	83,	P14	83,	P15	83,	P16	83,	P17	83,	P18	83
	P19	83,	P20	83,	ETO	0,	H2O	0.1,	WT	433.1				
15:16	'KLS													
15:16	17.3	129		117	CYCLE CONTINUED									
15:16	OPERATOR SENSOR CHECK --				PR	58.5,	RH	0,	JWT	140,	VLT	83,	VGX	117
	CT1	128,	CT2	130,	CT3	129,	P01	129,	P02	FAIL,	P03	FAIL,	P04	83
	P05	83,	P06	83,	P07	83,	P08	83,	P09	83,	P10	83,	P11	83
	P12	83,	P13	83,	P14	83,	P15	83,	P16	83,	P17	83,	P18	83
	P19	83,	P20	83,	ETO	0,	H2O	0.1,	WT	433.1				
15:16	'KLS													
15:16	17.3	129		117										
15:18	17.3	129		117										
MAX:	17.3	130		117	PHASE 0:30					PHASE ELAPSED 0:37				
MIN:	17.1	128		106						CYCLE 1:39				

AFTER VACUUM PHASE

15:18	17.3	129		117
15:20	10.2	128		117

SYSTEM RUN # 1695889

TIME	PRESS INHGA	TEMP (DEG F) AVG	RH %	VAP GAS	ALARMS & MESSAGES	ACTION TAKEN
15:22	8.9	128		117		
15:24	8.9	128		117		
15:26	8.9	129		117		
15:28	9.0	130		117		
15:30	9.0	130		117		
15:32	9.0	130		117		
15:34	7.1	130		117		
15:36	4.4	129		116		
15:38	2.8	129		116		
15:40	2.0	129		116		
15:40	2.0	129		116	EVACUATION PRESSURE	
15:40	2.0	129		116		
MAX:	17.3	130		117	PHASE 0:22	PHASE ELAPSED 0:22
MIN:	2.0	128		116		CYCLE 2:01

GAS WASH A PHASE

15:40	2.0	129		116	===== RELEASE 1 =====	
15:42	8.8	130		116		
15:43	15.0	132		116	===== EVACUATION 1 =====	
15:44	14.9	132		116		
15:46	7.9	130		116		
15:48	4.6	129		116		
15:50	2.8	129		116		
15:51	2.0	129		116	EVACUATION PRESSURE	
15:51	2.0	129		116	===== RELEASE 2 =====	
15:52	3.7	129		116		
15:54	10.7	131		115		
15:55	15.0	132		116	===== EVACUATION 2 =====	
15:56	11.9	132		116		
15:58	6.6	130		116		
16:00	3.9	130		116		
16:02	2.4	129		116		
16:02	2.0	129		116	EVACUATION PRESSURE	
16:02	2.0	129		116		
MAX:	15.0	132		116	PHASE 0:22	PHASE ELAPSED 0:22
MIN:	2.0	129		115		CYCLE 2:24

RELEASE PHASE

16:02	2.0	129		116
16:04	9.3	130		115
16:06	16.5	132		115
16:08	22.6	132		115

11. Phase » EO Inject by Pressure

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure	[mg/l] AT-EO	[lbs] EO Weight Used
3/18/2016				
13:59:04	132.2	6.4	173.0	70
14:00:04	132.3	7.3	224.8	86
14:00:53	132.4	8.0	263.8	98
14:00:57	132.4	8.1	267.1	99

Step Gas Usage

ID	Gas	Drum S/N	Lot Number	Usage Value
56	EO	E000086	UTLX902056B16	99lbs

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	00:05:54		00:01:00 - 00:30:00
Elapsed Phase Time	Final	00:05:54		n/a - N/A
TempAve	Min	131.6	°F	120.0 - 140.0 °F
TempAve	Max	132.4	°F	120.0 - 140.0 °F
PCurr	Final	8.1	inHg	7.0 - 9.5 inHg
PCurr	Final	8.1	inHg	n/a - 9.0 inHg
AT-EO	Final	267.1	mg/l	N/A - N/A mg/l
EO Weight Used	Final	99	lbs	N/A - N/A lbs

12. Phase » Static Dwell

(Phase No.11)

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure
3/18/2016		
14:00:58	132.4	8.1
14:01:58	132.4	8.0
14:02:58	132.4	8.0
14:03:58	132.2	8.0
14:04:58	132.1	8.0
14:05:57	132.1	8.0
14:05:58	132.1	8.0
14:05:58	132.1	8.0

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	00:05:01		00:04:00 - 00:06:00
Elapsed Phase Time	Final	00:05:01		n/a - N/A
TempAve	Min	132.1	°F	120.0 - 140.0 °F
TempAve	Max	132.4	°F	120.0 - 140.0 °F
PCurr	Min	8.0	inHg	7.0 - 9.0 inHg
PCurr	Min	8.0	inHg	n/a - N/A inHg
PCurr	Max	8.1	inHg	7.0 - 9.0 inHg
PCurr	Max	8.1	inHg	n/a - N/A inHg

13. Phase » EO Inject by Pressure

(Phase No.12)

14. Phase » EO Dwell with Nitrogen Makeup

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure	[mg/l] AT-EO	[mg/l] AT-AH	[%] RH Sensor
3/18/2016					
16:01:40	132.0	13.0	578.4	34.5	N/A
16:02:40	132.1	13.0	578.4	34.5	N/A
16:03:26	132.1	13.0	578.4	34.5	N/A
OPR	Operator has requested abort				
16:03:26	132.1	13.0	578.4	34.5	N/A

Device	Summary	Summary Value		Specified Range
Current Phase Time	Final	01:51:46		01:59:00 - 02:15:00
Elapsed Phase Time	Final	01:51:46		n/a - N/A
TempAve	Min	131.8	°F	125.0 - 135.0 °F
TempAve	Max	132.8	°F	125.0 - 135.0 °F
PCurr	Min	13.0	inHg	12.0 - 14.5 inHg
PCurr	Min	13.0	inHg	n/a - 14.0 inHg
PCurr	Max	13.1	inHg	12.0 - 14.5 inHg
PCurr	Max	13.1	inHg	n/a - 14.0 inHg
RH from AH Calc	Min	N/A	%	N/A - N/A %
RH from AH Calc	Max	N/A	%	N/A - N/A %
AT-AH	Min	33.6	mg/l	N/A - N/A mg/l
AT-AH	Max	35.4	mg/l	N/A - N/A mg/l
AT-EO	Min	545.5	mg/l	N/A - N/A mg/l
AT-EO	Max	578.4	mg/l	N/A - N/A mg/l
DVN	Current Phase Time has a measurement value of 01:51:46. The min specified value is 01:59:00			

15. Phase » Vacuum

(Phase No.14)

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure
3/18/2016		
16:03:26	132.1	13.0
SYS	Cycle has entered EO-Abort sequence while running Run ID 301852 at phase no. 14 - 0	
16:04:26	132.0	12.5
16:05:26	131.9	11.5
16:06:26	131.7	10.7
16:07:26	131.6	9.9
16:08:11	131.5	9.0
OPR	Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0	
16:08:26	131.5	8.9
16:09:02	131.5	8.9
ALM	Recirculation blower is enabled but not operational	
16:09:07	131.5	8.9
ALM	Recirculation blower is enabled but not operational	
16:09:19	131.5	8.9
OPR	Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0	
OPR	Operator has requested run mode	
16:09:26	131.5	8.9

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15. Phase » Vacuum

Date / Time	[°F] Avg. Chamber Gas Temp	[inHg] Current Pressure
3/18/2016		
16:09:29	131.5	9.0
OPR	Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0	
16:10:12	131.5	9.0
OPR	Operator has requested run mode	
16:10:12	131.5	9.0
OPR	Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0	
16:10:22	131.6	9.0
OPR	Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0	
16:10:26	131.5	9.0
16:11:14	131.6	8.9
ALM	Recirculation blower is enabled but not operational	
16:11:18	131.6	8.9
ALM	Recirculation blower is enabled but not operational	
16:11:26	131.6	8.9
16:11:51	131.6	8.9
OPR	Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0	
OPR	Operator has requested run mode	
16:12:01	131.6	8.9
OPR	Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0	
16:12:26	131.7	8.9
16:12:52	131.7	8.9
ALM	Recirculation blower is enabled but not operational	
16:12:57	131.7	8.9
ALM	Recirculation blower is enabled but not operational	
16:13:23	131.7	8.9
OPR	Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0	
OPR	Operator has requested run mode	
16:13:26	131.7	8.9
16:13:34	131.7	8.9
OPR	Chamber was placed in stop mode while running Run ID 301852 at phase no. 14 - 0	
16:13:55	131.7	8.9
OPR	Chamber was placed in run mode while running Run ID 301852 at phase no. 14 - 0	
OPR	Operator has requested run mode	
16:14:26	131.7	8.8
16:15:26	131.7	7.7
16:16:26	131.5	6.8
16:17:26	131.5	5.9
16:18:26	131.4	5.2
16:19:26	131.4	4.6
16:20:26	131.4	4.0
16:21:26	131.3	3.6
16:22:26	131.3	3.1
16:22:46	131.4	3.0
16:22:48	131.3	3.0



Ceilcote Readings:

T2 = 186 – Inches

PH = 1.2

Glycol = 36.3%

AAT Readings:

T2 = 105 – Inches

PH = 0.9

Glycol = 36.8%

Recorded By: _____

A handwritten signature in black ink, appearing to be 'G. J. 588' or similar, written over a horizontal line.

Date: 18-MARCH-16